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Aug. 1949

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toaster burns
vacuum cleaner
doesn't pick up
doors swell
windows rattle
stairs squeak
shingles get loose
radiators leak
floor boards buckle
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mouldings loosen
tiles break
termites attack
paint fails to dry



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refinish floor
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downspouts
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appliances
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Letters



Doing It with Mirrors

Sir:

I was particularly interested in your story, "Sun Furnace in Your Attic" (PS, March '49, p. 106), as I was, at one time, part of an expedition that dabbled in experiments with solar heat, back in the middle twenties, about the time the first successful experiments were completed in California.

From my experiments and experience, one thing stands out from this account: The profitable solar hours from this type of furnace could be greatly increased with a large mirror, pivoted on a swivel, and an electrical clocklike movement designed to keep the mirror in focus with the sun and aimed at the glass heat receptacle.

Our experiments convinced us that the old trick of using the focused rays of the sun to start a fire with a magnifying glass was the best premise on which to develop solar heat, and recalling how we used to start fires with a mirror and a magnifying glass, where no sun was shining and some times with a flash-light and magnifying glass, I thought possibly those who are currently engaged in solar research might use this idea to reach a greater efficiency with their current experiments.

W. M. PACKER

St. Louis, Mo.

Clock-run mirrors to concentrate the sun's heat have already been tried, but their complexity and high cost, at present at least, would make them uneconomical for small-home heating. Also, since high temperatures are not required for house heating, sufficient heat can be gathered from the sun without concentrating its rays. If such installations become practical, they will probably be most useful to large, solar-run, steam power plants that require high temperatures.

They're Both Fast

Sir:

I'll probably get my fingers rapped for beating my gums about an article written by a man who knows far more than I do. (I'm just a 4th former in high school.) Nev-

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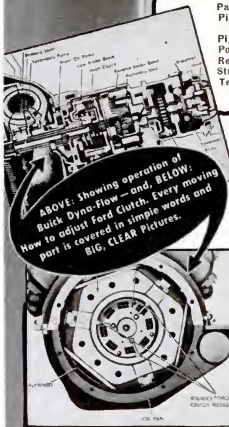
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The ROSICRUCIANS

San Jose (AMORC) California

ertheless, I would like to question a few points in Devon Francis' article on Ultramatic in the June issue [p. 139].

On page 140 he writes: "It (direct drive) gives extra acceleration fast," while on the next page he says: "If you need a sudden burst of acceleration, just push the pedal to the floor. Back you go to torque-converter drive." Now which does give the most positive acceleration—direct drive or torque conversion?

Another question is how can one accelerate in direct drive between 15 and 56 m.p.h.? Or can one? I saw nothing to hold the direct-drive actuating valve when the accelerator was depressed after the momentary release to shift the drive, but on page 142 it says: "This opposing hydraulic pressure . . . gives you a choice between the two drives at any speed between 15 and 56 m.p.h." If governor pressure couldn't open the valve before, how can it keep the valve open if the same governor pressure returns?

PHILIP EASTMAN

Burlington, Ontario, Canada

At low speeds, torque conversion gives you the faster acceleration—it's like going from overdrive in a direct-drive car back into standard third gear for a sudden burst of speed. At higher speeds, however, direct drive gives you the faster acceleration.

Going back and forth between direct and torque-converter drive is entirely a matter of opposing hydraulic pressures. The higher the speed, the faster the governor travels, and the more pressure it exerts. Up to 56 m.p.h., this pressure can be overcome by pressure from the accelerator pedal. Beyond that speed, it cannot. What may puzzle you is that the accelerator must be depressed until it strikes an abutment on the floor to actuate the pedal hydraulic system.

Longue or Lounge?

Sir:

In the June issue on page 169 you have "Lightweight Chaise Longue"—which, according to Mr. Webster, should be "lounge." Is this a trade name or merely a misprint?

C. E. CHAPPEL

Mission, Kans.

Neither Mr. Webster nor PS is at fault here. "Longue" is the French word for "long." Thus "chaise longue" means "long chair." "Lounge," despite its similarity,

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comes from an entirely different, Old French word—"lunig," which meant "lazy." Thus a lounge is also a place for lazy people. *N'est-ce pas?*

Old Trick with a New Twist

Sir:

After reading about slit veneer, called K-Veneer, in your April '49 issue, page 172. I would like to make the statement that cooks and seamstresses have known of that principle for years.

Seamstresses place small slits or clips around curves of seams or in corners to ease the material and make it lie smooth. Cooks slit the edges of frying meat, such as ham or pork chops, to prevent it from curling.

(Mrs.) R. HILL

Ilion, N. Y.

No Need to Window-Shop

Sir:

Thanks to you and your April issue [p. 148] for showing pix of the new Chrysler.

I am the fellow who never goes near an automobile sales floor until the moment he is ready to buy. (Like a young man purchasing a marriage license: no need to window-shop.) My mind is made up to duplicate our present job, a Chrysler Royal, within a few months. Your article assures me same will be no mistake.

FRED B. BARTON

Akron, O.

Flood Warning Rings Bell

Sir:

Your article "How to Foil a Flood" [May, p. 190] was so outstanding I want to compliment you on it. This article well suits the season of the year, and you did a fine job.

CRAIG YEANISH

Slatington, Pa.

Lead vs. Titanium

Sir:

We have read with considerable concern the article by George H. Waltz, Jr., in your May issue entitled, "New Paints That a Novice Can Use" [p. 153].

For instance, a new lead-free house paint was described with the comment that it resists darkening when applied to houses in or near large industrial areas where the air

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contains sulphurous fumes. Users, however must realize that to have a paint that will resist darkening, they must sacrifice durability.

A virtue is also made of the fact that these lead-free house paints are self-cleaning. Here, again, it should be recognized that they are self-cleaning because they chalk off and carry the dirt off with the paint. In other words, the paint does not push the dirt off but the paint itself wears away and carries the dirt with it.

Pictures are shown of a lead-free paint and a lead paint in Morgantown, W. V., which reveal considerable darkening of the lead paint after a relatively short time. It is not brought out, however, that such conditions are relatively rare. Sulphurous gases in general do not darken lead paint. Only hydrogen sulphide does that; the ordinary sulphurous gases found in most industrial areas convert the lead compounds in the paint to lead sulphate, which itself is white.

While titanium pigments have great merit in their whiteness and high hiding power, they are not chemically active pigments like the lead pigments. The lead pigments react with the oil with which they are mixed in

a paint to form a chemical compound which results in a tough elastic paint film. No such reaction occurs when titanium dioxide is incorporated in the paint, and in that respect it acts just like all inert pigments, such as silica, magnesium silicate, barium sulphate, and other extenders.

ROBERT L. ZIEGFELD,
Lead Industries Association
New York, N. Y.

Here is Mr. Waltz's reply:

I made no attempt to recommend any paint or type of paint over any other. I merely reported on new paints that are now available to the workshop-minded home owner who likes to do some of his own work. If there had been a brand-new lead paint fitted to the amateur painter's needs, it certainly would have been included.

I did point out, in the text, that it is the hydrogen sulphide gas that causes the blackening of lead paints, and that the self-cleaning process is a gradual flaking or chalking off of the lead-free paint.

I used several of the new titanium paints and, in my amateur way, was able to do a pretty good, professional-looking job.

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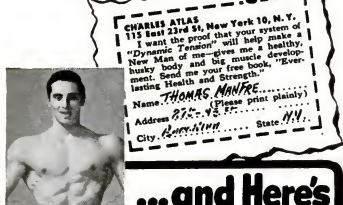
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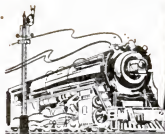
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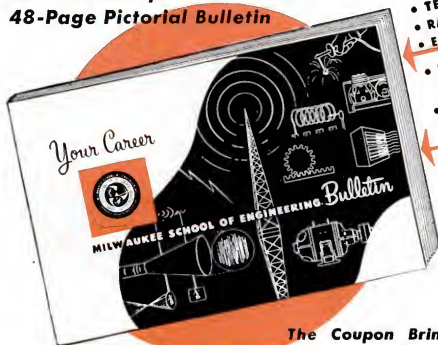
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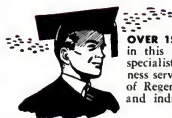
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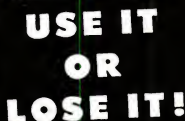
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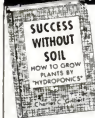
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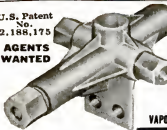
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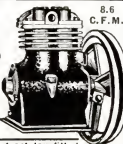
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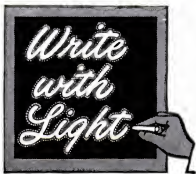
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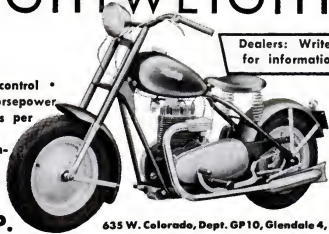
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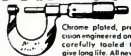
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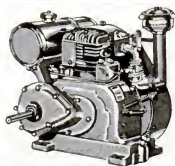
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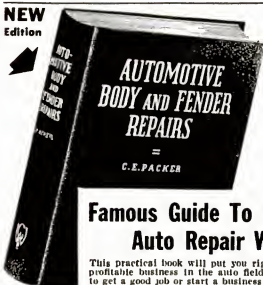
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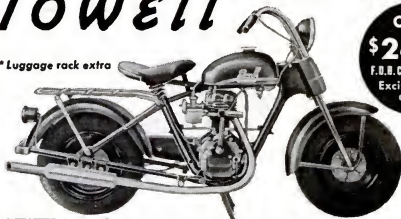
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EARN \$50.00 or more weekly operating vending machine route in your spare time. As small an investment as \$135 will get you started. Details free. Danco Coin Machine Co., Dept. PS, 1302 E. Baltimore St., Baltimore 31, Md.

"ELECTROPLATING-Know-How" includes baby shoe metallizing and other lucrative fields for you. Write for my free illustrated booklet! Joseph B. Kushner, Electroplating Consultant, Stroudsburg, 33, Pa.

"SPECIALTY" Manufacturing. Big money business. Start on small capital with dependable formulas. Send for Free interesting booklet. Howard Robinson, Ph. G., 1300-B South Ohio Street, Sedalia, Mo.

UNPAINTED figurines—Wholesale—Retail, illustrated list free! Oman, 642M Broadway, St. Paul 1, Minnesota.

"METALLIZE" Baby Shoes. Excellent profits. New system assures success. Free details. Treasures Forever, 89 Henry Ave., Lynn, Mass.

BIG MONEY—Spare or full time. Hand painting fabrics, ties, blouses, leathers, etc. is big business. New easy method. Help us fill demand. Free samples and complete plan. Hollywood Artlabs, 333-A E. 2nd, Los Angeles 2, Calif.

START Christmas Card Imprinting business. Write Dunbar, Middleburgh, N. J.

FOR an extremely profitable lifetime business, operate a Collection Agency—Credit Bureau. Easily learned. Free folder. Cole & Associates, Syracuse 2, New York.

BRONZEFACE Baby Shoe Mountings. Beautiful Designs. Ashtrays. Bookends. Picture Frames. Special Price \$12.00 Dozen Sets. Sample \$1.00 Prepaid. Bronzeface, 174 New York City, Jersey City, New Jersey.

DEPRESSION Insurance. Own money-making business. Information Free. Pru-Bx, Kingsport, Tennessee.

"METALLIZING Techniques"—Manual for plating baby shoes, etc. \$1 per copy. Plastics Research, Box 346, Alhambra, Calif.

HOW To Set Up and Run a Mirror Shop! Resilver Mirrors. Make chipped glass nameplates. Electroplating Salts and Recipes. John Sprinkle, V 90, Marion, Indiana.

MAKE money making new greaseless doughnuts at home on electric machine. Wholesale to grocers, drug stores, cafes, hamburger stands. Send for details and plans. Ray Do-Nut Company, 3605 South 15 Ave., Minneapolis 7, Minnesota.

MAKE Rubber Stamps. Feather Pictures. Detailize Baby Shoe Repair Dolls. Make plaster Novelties. Catalogue of "30 Ideas" Free. Universal, Box 1076-B, Peoria, Ill.

GET Into the Paint Business! Help fill increasing demand for top quality painted house paints, roof coatings, interior finishes, specialties. Sell direct from long-established manufacturer, full or part time, permanent advance commission, no investment. Particulars free, or send 50c for Sales Kit and start next week. Standard Industrial Products, Inc., Dept. PS-8, Evansville 4, Indiana.

MAKE strange plastic—1c pound. Makes attractive floors, walls, build-ins, roofs. Liquid churning house \$150.00 room, Bays Laboratory, Oklahoma City 2.

NATURAL holding liquid. Extra thick. Free Sample. W. Wooley, 115-B Donald, Peoria, Illinois.

POPULAR SCIENCE OPPORTUNITIES

MAKE Money spare or full time, casting Metal Toys and Novelties. Big wholesale and chain store demand for cast Metal Animals, Soldiers, Ashtrays, etc. keeps manufacturers busy. Production molds furnished for up to 100 and more castings per hour. No experience or special capital necessary. "Cash-in" on holiday orders now being placed. Write for full information and illustrations of patterns needed. Mast Cast Products Co., Dept. E, 1600 Edison Road, New York 66, N. Y.

400% PROFIT Making—Distributing Postwar Hand Cleaner. (Not Ammonia-Kerosene!) Free literature. Rhythmo-H-Ex. Kingsport, Tennessee.

TRADE Magazines help you get ahead. Latest single copies. Over 1000 covering every trade, business and interest. List with prices. Free. Commercial Engraving Publishing Co., 348 North Ritter, Indianapolis 19, Indiana.

"EVERYBODY Likes Candy"—Learn to make professionally (Our 39th year.) Ragadale Candies, D7, East Orange, New Jersey.

LIQUID Rubber. Make flexible molds. Free Sample, Chaney, 1130 E. 16th St., Jackson 6, La.

YOUR own profitable home business. Preserve live flowers to last forever. Spare or full time. New discovery—simple—fast—easy. No experience necessary. Send \$2.00 for working equipment, instructions and valuable sales plans. Satisfaction guaranteed or money refunded. Hermanen, 210 Fifth Ave., Suite 1102, New York 10, N. Y.

PLANNING a small mail order business? Booklet shows How. 36 pages full of opportunities. Copy only 10c. Special, Clarence Woodfall, Publ., Route 3, Charleston, Illinois.

ELECTROPLATE on non-metals. Instructions \$1.00. Four ampere plater \$19.95. 250 ampere \$29.30. Ampere \$85.00. Kissel Electric Products, 431 Sherman, Galion, Ohio.

MAKE—Perfume—Profitable mail order business. Information free. "International" 6347 Farnell-PS-8, Chicago, Ill.

QUICK Fortunes from this Fabulous New Oil Boom Colorado-Wyoming-New Mexico-Idaho. Shoot \$100 or so for 40 acre lease with possibilities to \$20,000 or more. List watch everything for you. Money Back 30 days if not pleased. Free particulars quick. Dyer-PS, 1835 Champa, Denver, Colorado.

FOR Penny-Ball Gum Vendors Factory To You Write Coastal Photo-Supply Co., Export-Division, Wallace, N. C.

"LIFETIME Repeat Orders!" Sell our Business Cards by mail, your territory. Small "Starters" Plan, Lynn Products, 5710-12 Bankfield, Culver City, California.

UNPAINTED Plaques. Novelties, figurines. Instructions dime. Perry Novelty Company, Perry, N. Y.

RAY shoe business. For Sale with or without manufacturing equipment, bookends, ash trays, photopanel, 400 satisfied retail distributors with samples. 25,000 Adm. 100 Folders, 4000 going. Help us fill huge demand. New easy Flo-Kraft methods. Material costs few pennies. You get dollars. Free samples, complete how-to money making plan free. Write now! Coast, 1008 S. Los Angeles St., Los Angeles 15.

ASSEMBLE Swiss Musical Churches. Complete Kit \$3.50. Sell on sight. Fittzeker Swiss Imports, Wood-Ridge, New Jersey.

WOULD you pay 3¢—first \$350 made? Illustrated book "505 Odd, Successful Enterprises" free! Work home. Expect something odd! Pacific, Oceanic, Calif.

100 BUSINESS Ideas—Formulas—Also 200 Plans for Heavy Duty Machines for Shop-Home-Plan. Piano Sales, 2505PO 150 St., Flushing, New York.

COIN machine that dispenses America's most popular and fastest moving candy bar. Terrific profit returns on investment as \$37. Unlimited opportunities. Saratoga-National Enterprises, 101, 2317 Fruitvale Avenue, Oakland 1, California.

FREE Folio. Wholesale Supply Sources. Business deals, Plans, Ideas, Formulas. Kolod, 302 Co. Box 3, Dayton, Ohio.

HOW and where to obtain capital? Free details. Star Service, Wapakoneta, Ohio.

BABY Shoe metallizing. Everything you need to know. Schoettie, Friendship 4, Ohio.

FIGURINES and all Supplies for Dresden painting. Gift ornaments. Unpainted, many to choose from. Start a profitable business—home—bushy. Send 25c for Catalog. Will refund on first order. Sultier Art Industries, 314 Westport, Kansas City, Mo.

REAL money making opportunity making Interlocking Concrete building blocks. Real Products Co., Dept. 21, Piquette, Ohio.

NEW Industrial Hand Cleaner. Free manufacturing-distributing plans. Unusual money-making proposition. "Acro-Sol-Ex," 623-D West 14th Ave., Denver 4, Colorado.

SAWDUST. Turn it into cash. Six methods. Instructions 25c. Charles, 12-FG, Norwood, Ohio.

COLORGLAZED Concrete Pottery made without molds. Patented method. Cemetery products, novelties, tiles. Basement leak-sealing. Money-making projects. Booklet, details free. Men only. National Potteries, Grand Rapids, Minnesota.

MAILING postcards selling retail merchandise is profitable. Everything supplied. Details free. Gordon Publishers, Box 23, St. Louis, Mo.

GLASS-Cast. The Liquid Plastic that works the quick and easy way. Cold-Set. 15 to 30 minutes for finished product. Free Samples and Instructions. Make embossed novelties, novelties, frames, machine parts, etc. for real profits. Two lbs. for \$2.95. Elastomold: Flexible production molds made in 20 minutes. Also finest quality Super Latex. Wholesale Prices. Plastic Service, 294 Washington Street, Dept. K-2, Boston 8, Mass.

SPARE minutes bring dollars selling this new burn ornament. Free details. Clover Products, 11860 Mississippi, Los Angeles 25.

BRONZING shows profits. Literature concerning equipment and process free. Luther Jones, Box 7283, Ft. Worth, Texas.

BIG MONEY Regraining-Refinishing Automobile Dashboards-Garnish Moldings for Automobile Owners. Dealers. Shops. Profitable-Fascinating-Undeveloped Field. Full details. Write Outman, 4223 So. 28th St., Little Rock, Ark.

LEARN Piano Tuning. repairing at home. Tremendous field! Piano parts, tools furnished. Established 1935. Empire School of Piano Tuning, 606-A East University Avenue, Champaign, Illinois.

EARN At home. casting novelties. Free course using latex molds. Major Chemical Co., 164 Portland St., Cambridge, Mass.

MAKE Big Money in Home Mail Business! Few dollars starts you—interesting profitable! Write: Smith, Box 2592, Hines, Illinois.

\$46 FROM Square Foot Plywood; Jigsaw necessary. Write: Woodart, Bridgewater, Massachusetts.

BIG money. Spare or full time in your home. No Selling! Spray New Miracle Finishes. Plush and Suede, on signs, radios, automobiles, figurines, lamps, toys, etc. Our business is booming. Help us fill huge demand. New easy Flo-Kraft methods. Material costs few pennies. You get dollars. Free samples, complete how-to money making plan free. Write now! Coast, 1008 S. Los Angeles St., Los Angeles 15.

WOULD You Like to earn \$2 to \$5 an hour reupholstering friend's or your car. Post card for details. First Upholstery Service, 727A West Congress St., Brookhaven, Mississippi.

HOME Business. "Learn How To Fix Cracked Batteries!" Money-maker. Instructions \$1.00. Batteryman, Grand Junction, Colorado.

FREE Book "372 Unusual Worldwide Business Opportunities" South America, \$800.00 month reported (exceptional). Work delightful enterprises home. Prepare for surprise! Publishers—C8, Carlsbad, Calif.

HIGH readership—over four million! Low cost—only 80¢ a word. That's what you get when you place your classified ad in Popular Science Monthly. You also get profitable results. Write for order form to O. K. Kelly Classified Advertising Manager, 351 Fourth Ave., N. Y. C. 10.

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MONEY MAKING OPPORTUNITIES

NO selling. operate coin machines, amazing profits, details free. Parkway Corporation, Dept. 18, 623 W. North Avenue, Baltimore 17, Maryland.

PROFIT with Larson Leathercraft. Bells, purses, 100 other ideas. Largest supply in U. S. Catalog 10c. Larson, Dept. C, 828 S. Tripp, Chicago 24.

LEARN Sewing Machine Repairing at home. Install our wholesale motor kits. Make \$12 to \$300 a week. Free particulars. Taylor Service Co., Hamilton PS, Ohio.

DETECTIVES Earn Big Money. Experience unnecessary. Particulars free. Wagner, P-125, West 86th, N. Y., N. Y.

SHELLCRAFT! Make beautiful sea shell jewelry. Income or Hobby. Pace's, Box 2708P, Bradenton, Florida.

200 SELECTED Money Making plans 50c. Special offer. New York Publishing Co., 86-44 121 St., Richmond Hill 18, New York.

DOLLARFUL Ideas for you Every Month in Advance. Voice of Mail Order. Details Free. Advance Publishing Company, 313 East 21st Street, Suite 800, New York 10.

OPPORTUNITY COPY Fair Monthly. 25c. Distributors wanted. Brewster, Eastport, Maine.

WOULD You pay 3¢—first \$350 made? Illustrated book "505 Odd, Successful Enterprises" free! Work home. Expect something odd! Pacific, Oceanic, Calif.

173 WAYS to Make Money at Home! "Big book yours as gift! Tells how to play for pay. Given with special trial subscription to Profitable Hobbies—read by 100,000 ambitious folks. Four big monthly issues only \$1.00. Money Back guarantee. Write Profitable Hobbies, 7641 Hobbies Building, Kansas City 16, Missouri.

MAKE extra money at home in spare time. Raise Golden Hamsters. Small investment. Literature free. Golden Gate Hamsters, 631-G Richmond St., El Cerrito, Calif.

INTERESTING money makers 25c. Satisfaction guaranteed. Dawson, 1308F, The Dalles, Oregon.

GLAZED Donuts! \$500 Monthly. Positively Easy. Comprehensive Instructions. Goldenrich Course Complete, \$15.00. Goldenrich Bakeries, Hastings, Nebraska.

NO Work. No cost. Fabulous money paid for Dwarf Trees, grown in your room. Details for stamp. American, 385 La Tijera Station, Los Angeles 43, California.

\$100 WEEKLY. Own boss. Sell mothers. Leads spare or full time. Details \$1.00. Hamlin, 6215-16 Heliotrop, Bell, California.

OPPORTUNITY for your classified ad to be seen by over four million readers in Popular Science Monthly. Write for order form to O. K. Kelly, Classified Advertising, 351 Fourth Ave., New York City 10.

58 FORMULAS, PLANS, ETC.

FORMULAS—All kinds. Latest products. Literature free. Kemico, Park Ridge 15, Illinois.

10,000 FORMULAS and Trade Secrets Free Literature. Stillmans, 555 Kingston Ave., Brooklyn 3, N. Y.

PRODUCTS analyzed. Duplicated. Improved. Formulas. Scientific Company, Swarthmore, Pennsylvania.

GROW plants without soil. Formula and instructions \$1.00. Young, 219 Strathmeade St., New Church, Va.

LABORATORY tested formulas. Lists free. Post. Box 635-PS, Terre Haute, Ind.

FORMULAS. Secret Laboratory Tested. Big Profits—Small Investment, 15—\$1.00. Edmunds, 317 E. 157th St., Bronx, New York.

FREE Formula Catalog. Anything Analyzed \$20.00. Western Chemical, Salem, Oregon.

59 PLASTICS

PLEXIGLAS—Write for Free Price List The Unique Glass Shop, 309 Court Ave., Richmond, Virginia.

POPULAR SCIENCE OPPORTUNITIES

PLASTIC supplies, materials, instructions for hobby or business. Send for free catalog. Tells about internal carving. Hays Plastics, 2333 Lincoln Avenue, Alameda, California.

NEW Liquid Plastic. Clear, colors. Cast without heat. Etched. Photo-Slates, coins. Saw, drill, carve. Complete kit only \$3.95 postpaid, or send 25c for exciting new home project manual showing how to get started. Castolite, Dept. J-104, Woodstock, Illinois.

LUCITE Plexiglas. Any size sheets, masked. Square foot (12 x 12 in.) cost, 1 1/8 95c; 1/4", \$1.25; 3/16", \$1.50; 1/2", \$1.80. Colors add 10%. Include 10¢ postage. Almac Plastics, 230 Fifth Avenue, New York 1, N. Y.

PLASTIC Sheets, Rods, Tubes, etc. Free List, Plastic Supply Co., 2901 N. Grand Blvd., St. Louis 7, Mo.

FLEXIBLE Mold Making Handbook. Be an expert. Send only \$1.00 for your postpaid copy today. Multi-Mold Products, 265 West 30 Street, New York 1.

60 CHEMICALS AND APPARATUS

NEW Idea Chemical and Apparatus Outfit for Home Experimenting. Photo-Slates, Microscopes, Chemicals, Biological and Laboratory Supplies in Small Quantities. Catalog 15c. Established 1931, John H. Winn, 124-B West 23rd Street, New York, N. Y.

MAKE Chemistry Your Hobby. Fascinating, Educational, Recreational, Vocational. Large general catalogue Chemicals and Apparatus 15c. Microscopic Stain Catalogue 30c. Both for 25c. National Scientific Company, (Est. 1916), 2204 W. North Ave., Chicago 47, Illinois.

HANDBOOK for Chemical Experimenters, illustrated, hundreds of experiments. 50c. Experiment book, 15c. Reading Scientific Co., Reading, Pa.

NEW catalog: Chemistry, mineralogy, biology, physics 10c. Tracey Laboratories, Evanston, Ill.

CHEMICALS and apparatus for industrial, analytical, and private laboratories. Catalog 15c. Dept. M-26, Biological Supply Co., 1176 Mt. Hope Ave., Rochester 7, N. Y.

COMPLETE supply catalog. 10c. Pilgrim Chemical, 348-U Edith, Salt Lake City 4, Utah.

61 HELP WANTED

BOYS Wanted. Over 2,000 hour! Sell name plates for front doors. Free Sample. Write Dept. 69, National Engravers, 214 Summer, Boston, Mass.

ALASKA. The Last Frontier offers unlimited opportunities. 15 brings government map and Directory listing firms in Fishing, Construction, Mining, Aviation, Fish & Game rules, Homestead data. Alaska Opportunist, Box 883-S, Hollywood 28, Calif.

FOREIGN Construction Work. Construction men, building, trades, mechanics, helpers, office men, Good workers needed for oil projects, mining, pipe lines, dams, power plants, roadways, shipping, etc. Transportation and quarters furnished; high wages. Listings of firms actively working and hiring on projects in South America, Arabia, India, Africa, Alaska, Central America, etc. Send \$1.00 for foreign construction compendium and application form. Foreign Service Bureau, Dept. PS-8 (Employment), P. O. Box 295, Metuchen, New Jersey.

APPLIANCE Designer. Well established position in mid-west has permanent salary position for a man 35 years of age or older to design develop and follow through on mechanical and electrical household applying and dispensing equipment. Write full stating experience, salary requirements, and give references. Replies will be held confidential. Leave Room 1158, Merchandise Mart, Chicago 54, Illinois.

100,000 CONSTRUCTION Job Project (pr. \$1.00 brings Monthly News Bulletin) "giving authentic projects starting Aug. wide." U.S.A., Alaska, Canada, Mex., Arabia, Latin America, India, West Africa, Europe. Tells How-When-883-20 apply. Global Reports, P. O. Box 883-S, Hollywood 28, Calif.

BIG-Pay Jobs available. Particulars free. George Lenhoff, Lincoln 8, Nebraska.

FOREIGN Employment?? List of Overseas projects with application form. \$1.00 Cash (C.O.D. \$1.32). Foreign Service Institute, Box 3980, Miami 24-A, Florida.

INTERESTED In Latin American and Foreign Employment?? \$1.00 brings copyrighted "Foreign Service Directory" with complete listing of firms in Oil, Mining, Aviation, Construction, Steamship, Manufacturing, Importers and Exporters with Hot Tips for immediate application. Published since 1944. Global Reports, P. O. Box 883-S, Hollywood 28, Calif.

62 AGENTS WANTED

GOOD Paying Business Silvering mirrors, plating autotaps, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet, Gunmetal Co., Ave. G, Decatur, Illinois.

EXCELLENT Sideline for printing and advertising salesmen. Decimania name plates in small quantities. Great demand. Includes Personalized Business Cards, Automobile Initials and Sign Letters. Free Samples, "Ralco", XL-Roxbury, Boston 19, Mass.

AGENTS-300% profit selling genuine gold and silver jewelry and other Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

FREE water and our concentrates make favors, lotions, shampoos, 125 products. Labels, bottles supplied. Quilco, F-2030 Russell, Detroit.

STOP! Want To Make Money All Year Round Selling a complete line, Wool Uniforms, Shirts, Caps, Ties, Badges, 2000 Embroidered Personalized Buckles, Belts and hundreds of other easy-to-sell items. Sales Kit furnished. Please write today. Hook-Fast Company, Box 480-PS, Rosedale, N. Y.

ADVERTISING book matches—Cash in on big demand—sell Union Label matches. Cuts for all businesses and political parties—Free powerhouse selling kit—low deposit—we deliver. Profitable sideline. Orders—cash commissions. Superior Match Co., Dept. P-89, 7530 Greenwood, Chicago.

PHOTO-Salesmen-Agents. Sell beautiful hand-colored plastic enlargements. Collect deposit—we deliver. Profitable sideline. Send card for free sample kit. Novel-Fil Co., 3343-A North Ave., Chicago 11, Ill.

SEWING Machine electrification kit. Nationally advertised. Has Good Housekeeping Guarantee Seal. Can be demonstrated and sold in 5 minutes. Make at least \$3 per sale. For complete details write today to Brownell Distributors, Inc. Dept. PS, 308 Canal St., New York 13, N. Y.

START Your Own Business On Credit. Always your own boss, 1954 Dealers, sold \$60,000 in 1948; 1949, \$75,000, average \$6,742. We supply stocks, equipment on credit. 200 home necessities. Sales experience not needed to start. Wonderful opportunity for own business. Profitable business backed by world-wide industry. Write Rawleigh Co., Dept. H-U-PSC, Freeport, Ill.

LOOK! Make money all year round selling personal initiated individualized belts, buttons, name badges, western buckles, tie holders, name plates, 2000 emblems to choose. Big profits, whole or part time. Please write today special outfit buffer. Hook-Fast Specialties, Box 1425, Dept. 7, Providence, R. I. Established 1926.

BE renewal headquarters for all magazines. Handle everything at home. Big business, no experience. No cash advance. Free Catalog tells how. Write McGregor Magazine Agency, Dept. 139, Mount Morris, Ill.

BE best! Clean up selling brilliant new metal Christmas cards featured in America's greatest box assortment line. Special metal, plastic, foil and novelty designs. Five popular designs. Free samples. Elmcraft Chicago, 5930 South Western, Chicago 36, Ill.

ABSOLUTELY Free! Big package actual samples of dresses and stylish preearable dresses, lingerie, hosiery, etc. Take orders. Commissions big. Send money. Melville Co., Dept. 3104, Cincinnati 3, Ohio.

GOLD lacquered Window Signs Letters. Large Sizes Penny Each. New Folds. Absolutely Beautiful. Free Samples. Atlas, 544 W. 79th, Chicago 20.

AMAZING offer—\$40 is yours for selling only 50 boxes Christmas cards. Also 50 and 25 for \$1.00 without name. Free samples. Other boxes on approval, including entirely new, different deluxe assortment with feature television card. Cute plastic assortment. Write today. No costs nothing to try. Cheerful Card Co., 844 White Plains, New York.

A DRESS Yours with every 3 you order for yourself and family. Amazing new bonus plan. Everything Free. Harford Frocks, Dept. A-335, Cincinnati, Ohio.

PROFITS. Big demand and repeat orders selling rubber mats for home or auto. Free sales plan, Mitchell, Dept. PS8, 2140 San Fernando Road, Los Angeles 41.

SHINE Shoes Without "Polish". New Invention. Lightning seller. Shoes gleam like mirror. Samples sent on trial. Kristee 132, Akron, Ohio.

EXTRA Money! Sell friends Christmas Cards—including fascinating Plastics. 100% profit. Request free samples Extra! Name-Imprinted Christmas Cards. Stationery unobtainable elsewhere with Christmas and Everyday Assortments on approval. Get Free Greetings. Dept. PS-8, Hazel Park, Mich.

CALL On Friends with sensational Christmas Cards in handy assortments. Sell for \$1.00. Profit up to 50c. Also popular-priced Personal Christmas Cards. Everyday assortments. Stationery. Imported Napkins. Samples on approval. Wallace Brown, Dept. B-4, New York 10, New York.

QUICK, easy cash for you! Sell amazing variety new Christmas cards. Profits to 100%. Novel Plastic, 3-dimension "Stage Set". Metallic, Christmas Carol cards, 100% profit. Free samples. Christmas Table Settings, 8 special offers. Bonus. Write for feature samples on approval and free samples 4 different Name Imprinted Christmas Cards. Floral and Personal Stationery. Elmira Greeting Card Co., MB-110 Elmira, New York.

AT Last! Something new and sensational in Christmas Cards. Show Gorgeous Satins, Velours and Plastics never before offered. Get Free Orders Fast! Pays Big Profits. Free Samples of Christmas Cards With Name 50 for \$1. Imprinted Stationery. Floral Charmettes, Napkins, 50 other assortments 60c to \$1.25. Samples on approval. Write, Puro Co., 2801 Locust, Dept. 941-K, St. Louis, Mo.

BIG Money Taking Orders: Shirts, Ties, Sox, Pants, Jackets, Sweaters, Shoes, Uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-AV Lincoln, Chicago.

NEW Sensational money maker. "2-in-1" scissors and knife sharpener. No-in-1 like it before. Proven success. 100% profit. 30 second demonstration gets order. Special Trial Offer. Barberdier, 916 Eleventh, Sacramento, Calif.

FREE Samples. Big profits showing amazing Glow-In-The-Dark Stationery. House numbers, pictures, plastic novelties, religious and nursery objects, etc. Large manufacturer, Madison Plastics, 303 Fourth Ave., New York 10, N. Y.

SELL Calendars now. Be the first in your district. Good sideline or full time. Every business wants them. Few calendar salesmen are on the road now which means big sales for you. Send for calendar Co., 6539 Cottage Grove, Chicago 37.

MAKE money easily. New spare time plan. Up to 100% profit. No experience. Show sensational Christmas Cards, Christmas assortments, Plastics, Glean and Glo, Kiddies Cards, Wrappings, Attractive Gift items, Bonus, Special offers. Send today for free samples 30 different Christmas cards with name, 50 for \$1.00 up. Stationery, Coasters, Thomas Terry Studios, 100 Union Ave., Westfield, Mass.

SALESMEN-Sideline. Earn \$300 next 5 months selling Christmas advertising specialties. Buyers everywhere. Big Comm. advanced. Samples Free. Continental Calendar, 542-B South Dearborn, Chicago.

POPULAR SCIENCE OPPORTUNITIES

MAKE \$500 selling only 100 boxes America's leading 21 card Christmas assortments. Samples on approval. Complete line plastics, wrappings. Free samples \$30 for \$1.00 Name Imprinted Christmas cards. Write Lorain Art Studios, Dept. A1, Vermilion, Ohio.

EXTRA money quick! Take easy orders low cost—high profit. Christmas cards. Wonderful new type Plastic. Metallic assortments. Send at once for free 48-page catalog. Feature plastic Christmas cards. Free Name Imprinted Christmas Card sample portfolios. Special offers. New England Art Publishers, North Abington 51, Mass.

PROFITS! Galore! Make \$100 weekly easy by offering valuable gift premiums with subscriptions to leading magazines everybody buys. Write for details. Progressive Sales Company, 1611-P Walnut St., Philadelphia, Pennsylvania.

OWN Your Own Business. Sell Men's Neckwear full or spare-time. Low investment, big profits. Send \$1.00, receive two sample ties plus free catalog, color portfolio, selling plan. Radio City Jewelry Dept. P.S. I, 112 W. 50th, N. Y. C.

GET INTO the Paint Business! See our ad in Business Opportunities, Standard Industrial Products, Inc., Dept. PS-8, Evansville 4, Indiana.

EARN Extra Money easily. Sell new Christmas cards and Gifts—N-Things. 21 folder Ass't sells for \$1.00, sent on approval; no investment. Get \$50 or more selling only 100 boxes. Complete line. Offers. Headquarters for new 3-dimension Christmas Cards, Plastics, genuine engraved etchings. We send Free Samples of easy-to-sell personal Christmas cards and stationery. Pen-n-Brush Studios, Dept. PS-8, 139 Duane St., N. Y. 13, N. Y.

SELL Big Money-Maker to men and Women. Easy handwork makes fast-selling useful articles. Send for free. Sunmade Company, Brockton, Mass.

SELL ultra-blue stock signs to stores. 1000 slogans, comedy, general, religious. "X11" cost 60c—Sells 35c—Make money. 15 sample Ultra-blue Signs. Send for free. Postpaid, L. Lowy, 8 West Broadway, Dept. 487, New York City 7.

SELL Large Profit Merchandise. Write Adams, 15 Park Row, Room 1216, New York 1, N. Y.

1940 CHRISTMAS Card Catalog Now Ready! Earn more money! Be a wholesale jobber! A large selection of Box Assortments, Imprint Lines, Religious, Personalized Cards and Christmas Novelties. Three sample boxes, retailing for \$2.00, only \$1.00 postpaid. Catalog Free! Elkfo, 440 North Wells, Chicago 10.

DON'T sell junk! The Frawley Chairside Coin Radio is in America's finest hotels. Proven and accepted! Your local operators, courts, hospitals, resorts, coin operators, investors, radio men, etc. are all prospects. Splendid commissions! Time payment plan and complete sales help for easy selling. Write today! Hotel Radio Corporation, 3000 E. Jefferson Ave., Detroit 7, Michigan.

BUY thousands of nationally advertised products direct from manufacturers and distributors. Write for "Save, Direct and Save". Service Publishing, 218-B Investment Bldg., Pittsburgh 22, Pa.

WOULD you pay 3½c—first \$350 made? Illustrated book "500 Odd, Successful Entrepreneurs" free! Expect something odd! Pacific, Oceanide, Calif.

PAINTS—Enamels, Roofing 65c Gal. up. Your name on label. Certified Products, 816 38th, Louisville, Ky.

WHERE To Buy 800,000 articles direct from manufacturers. Send for "Your Profits Under the Spotlight." Glass Publishing Company, Ellwood City 3, Pa.

BRAND New Amazingly different and smart Christmas Cards bring you big money! Take easy orders for sensational new Christmas Cards. Amazing values, says up to 100% cash profit. Big line of Christmas, Everyday Assortments from 60c up. Christmas Cards With Name 50¢ for \$1. up. Imprinted Stationery, Floral Charmettes, Napkins. Get samples on approval, imprints free. Write North Star, Glenwood, Dept. A-19, Minneapolis, Minn.

FREE Nylons given if Kendex hosiery runs or snags! World's only women's hosiery with fully written guarantee—miraculous! Merit words could not express unbelievable money making opportunity. Fantastic earnings become reality. Armstrong's Hosiery, 3000 N. 3rd, Wash. Jc., Ind. 92 orders in one day. Imagine replacing hosiery free regardless of cause—whether worn, snagged, or torn. Earn money on terrific profits. Even if you never sold before, three magic words: "Guaranteed Against Everything" will open doors for you—make money every day. Thousands shipped daily. 100,000 pairs constantly in stock for fast delivery. Over 30 years in business. You need no money or experience. Nothing to pay now or later. Show free outfits. Write orders. We deliver and collect. Big advance bonus. Huge bonus. Earn money part or full time—exclusively or side line. No restrictions. Become manager—appoint others to sell for you—earn steady income from their sales. Complete money-making outfits including salesbooks in color, samples of hosiery materials, etc. furnished free and mail Simple money-making plan. Address to: Kendex Company, Babylon 84, New York.

TRACTORADIO (Tractors-Trucks). Sensation. Earn yours—Free. Smith Agency, T-2017, Excelsior Springs, Missouri.

HOTTEST 39¢ Item on the market. National Sales & Service, Greenville, Pa.

SELL!! Balloons, Combs, Specialty Merchandise. Carleton House Distributors, Texas City, Texas.

New Jobs open in selling! Send name address. No free issues of Opportunity Magazine's money-making guide. Listing hundreds of companies who'll pay you well full or part-time. No experience needed. Opportunity, 28 E. Jackson, Dept. 18, Chicago 4, Ill.

MAKE Money selling Christmas decorations. Details from Wailes Christmas Company, 400 Lexington, New York.

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NEUROTIC. Write about yourself, offering gracious. Artisan Psychiatrist, 281 E.M., Watertown, N. Y.

125 WOODS

WOOD cards, Business, Christmas, Announcement. Cards of Wood, Manlius 2, N. Y.

126 CAMPING

TENTS, war surplus, all sizes; cots, hammocks, camping equipment, canvas covers, fishing & sporting goods, rope, Mossan, 10-19D 50th Avenue, Long Island City 1, New York.

131 TREASURE FINDERS

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137 DETECTIVES

DETECTIVE Training, Phillips Secret Service System, 1917C North Kenneth, Chicago 39, Illinois.

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The farmer looked at his untilled acre.

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. . . because of their race, their name or their religion.

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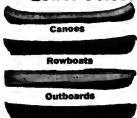
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Safety markings on home ironers. It's often difficult to see when the roller is revolving. A wavy line on the roller cover would show at a glance when the machine was operating.—Herbert E. Fey, New Braunfels, Tex.

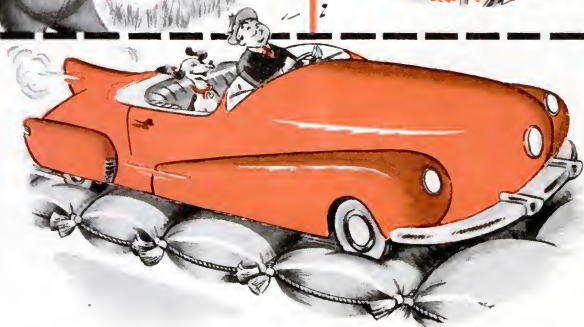


A home soap press. Working on the principle of an injection molder, this gadget would take accumulated small slivers of soap and squeeze them into one cake. Unless dry, they'd pack solidly.—Eric St. Clair, Richmond, Calif.

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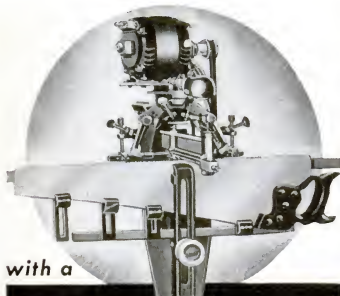
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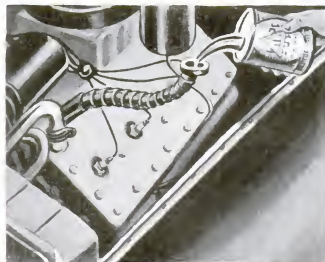
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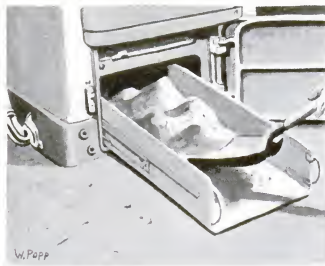
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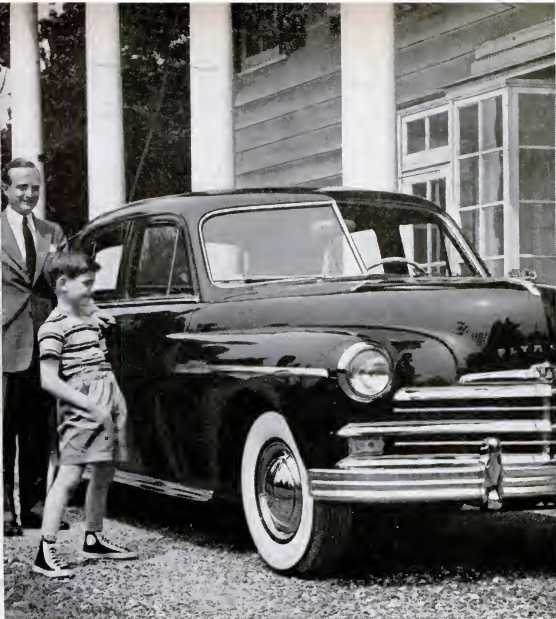
Childproof sections in medicine cabinets. If a small compartment—built into one of the shelves—could be locked, dangerous drugs could be kept from kids. It'd also help stop mistakes caused by sleepiness.—W. Beglen, Pittsburgh.



Telescoping oil filler pipes. They could be pulled out and turned to the most convenient angle for pouring oil into the crankcase from ordinary containers. Less oil would be spilled on the engine.—Noble Peeler, St. Paul, Minn.



Rolling ashpans. Tracks and rollers similar to those on the drawers of filing cabinets would let you roll the ashpan out of the furnace for easy removal of the ashes.—Douglas Verduin, Hawthorne, N. J.



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RCA scientists find way to combat noises in rooms where normal sound control methods are impractical.

These "Cones of Silence" smother sound!

You think of RCA Laboratories—in part—as a place where scientists work with *sound*, for radio, television, phonographs. This is true, but they are also concerned with *silence*.

One example is a recent RCA development, a way of killing clatter in places where conventional sound-conditioning—with walls or ceilings of absorbent materials—would get in your way. Overhead pipes,

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from American publishers for use in institutions training students like you yourself, your kid brother, or your son.

These books, handy packages of American ideas, will go to Austria, Belgium, Czechoslovakia, Finland, Italy, France, Greece, Korea, Japan, the Netherlands, Norway, Poland, Great Britain, western Germany zones, and all Berlin. So unless you are one of those rare Americans named Powhatan or Massasoit, these books will go back where some old man of yours probably came from.

The people at **CARE** say that for \$10 you can name your country, or even the kind of books or institution. If you've got that kind of money, send it direct to **CARE**, 20 Broad St., New York. But if a buck is a buck to you, too, or if you think a lone dollar is little, just remember there are a lot of us between the pages of **POPULAR SCIENCE**. A buck apiece would feed a lot of libraries—and minds. *If you will print your name and address under mine on this page, and send it with your dollar to CARE, 20 Broad St., New York, I will personally pick one name out of the hat to receive the original painting for the cover of this issue, suitably inscribed by the staff and the artist.*

Perry Giffkins

*Piston Rings
need
replacing, too!*



WHEN OIL-PUMPING flashes its warning that your piston rings are worn out, don't delay. The sooner you replace worn-out piston rings the longer your engine will last.

Fortunately, rings are *easily* replaced. And when you replace

with Hastings piston rings, you *stop* oil-pumping, *check* cylinder wear and *restore* performance. It's the best money you can spend on your car.

HASTINGS MANUFACTURING COMPANY
HASTINGS, MICHIGAN
Hastings Ltd., Toronto



HASTINGS
Steel-Vent Piston Rings

"TOUGH... BUT OH SO GENTLE"

TOUGH on oil-pumping — **GENTLE** on cylinder walls

POPULAR SCIENCE

REG. U.S. PAT. OFF. *Monthly*



Nerves of Steel... These sweeping, intertwining ribbons of steel are part of the thousands of miles of pipes that are the "nerves" of a large oil refinery. Just as human nerve fibers transmit sensations of heat, cold, pain, and pressure to the brain, these pipes transmit vital data about the cracking process from the refining plant to the control station. Here the small pipes are pneumatic lines that transmit pressure, rate of flow, and level of a liquid by minute pressure variations in tiny streams of air. The larger pipes carry samples of liquids and gases produced by the process, tapped off for direct measurement of pressure. The installation above is part of the Humble Oil & Refining Company's butyl plant at Baytown, Texas.



Guided missiles, fired from heavyweight fighter and designed to "home" on their target,

Can Superfighters Stop

Are the huge new bombers invincible? Have they made fighters obsolete? Or will big, new "fighter-bombers" be the answer to air defense? **POPULAR SCIENCE** assigned a tough-minded reporter, with no previous military experience, connections, or prejudices, to interview the experts—military, civilian, and scientific. Here is his evaluation of the hottest argument in the history of air power.

THE EDITORS

THE whispered words, "Bee Thirty-Six," will start an argument anywhere in aviation. And there are no neutrals in the war of words that has burst about this most controversial of all airplanes.

The Air Force says the B-36 can get out of town, do a job, and get back. The claims that these warplanes can take off from continental U. S., fly through enemy defenses, hit any major industrial area in the world, and come home nonstop, have been made the subject of a Congressional investigation.



would be most logical weapon against elusive new bombers. They could be ready to use soon.

the Bombers?

By Herbert Yahraes

Drawings by Ray Pioch

They have also challenged the whole history, theory, and practice of air defense.

Bombers, historically, have always been vulnerable to fighter planes. Big warships have been sunk by torpedoes (the original guided missiles) fired by little warships and aircraft.

Why has moving the battlefield a mere two miles (straight up) from where it was in World War II seemingly changed all the rules? What happens at 40,000 feet to enable big planes to escape little planes?

These were some of the questions tossed at me. I was told I had been chosen for this chore because all the regular aviation writers and military writers affiliated with POPULAR SCIENCE either had served with the Air Force or the Navy, or had worked so closely with bombers or fighters that they might have unconscious prejudice.

So I talked to airmen in Washington and elsewhere. To salty fighter pilots now bright with brass, and peppery bomber boys now baldly gleeful. To scientists con-

LOW SPEED
AND
ALTITUDE



MORE
HITS

WORLD WAR II BOMBER
WAS SLOW ENOUGH TO BE
RIDDLED WITH BULLETS
WHILE PASSING THROUGH
FIGHTER'S "CONE OF FIRE"



HIGH SPEED
AND
ALTITUDE

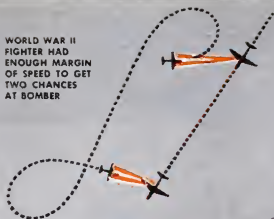


FEWER
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MODERN BOMBER IS FAST
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WORLD WAR II
FIGHTER HAD
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OF SPEED TO GET
TWO CHANCES
AT BOMBER



PRESENT SPEED RATIO GIVES
FIGHTER ONLY ONE CHANCE AT
BOMBER BEFORE LOSING CONTACT



Drawings show reasons for bombers' decreasing vulnerability. Above, the bomber's greater speed lessens exposure to fire from fighter.

Fighter plane gets fewer opportunities for "passes" at bomber because of its shrinking speed advantage and loss of maneuverability.

cerned with the mathematics of the higher altitudes. To civilians now in laboratory and airline work who were pressing trigger buttons or dodging flak only a few years back. All of them tried to convert me to their very real faith.

The tough truth seems to be that big airplanes, flying very high and very fast, cannot easily be downed by little airplanes flying no matter how fast.

Imagine that you are an Air Force fighter pilot. What they call "early-warning radar" has spotted bombers a scant 200 miles away. That's about as early as radar can get right now. And that's about half an hour horizontally, plus whatever time it takes to get upstairs. How long it takes to get upstairs is another argument. But let's suppose you are up—and at 'em.

You are jockeying a jet job, screaming something over 500 m.p.h. You can even see your target. You start your gunnery run.

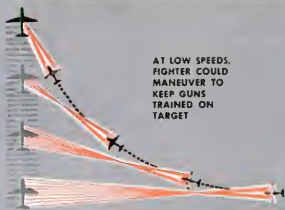
If you attack head on, your closing speed is 15 miles a minute. If the effective range of your guns is 400 yards, that means you have slightly less than one, single-second in

which to do business. And, at such speeds, one "brpp" can put only a handful of slugs into one, single bomber.

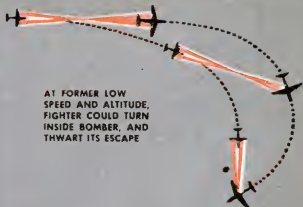
If you try what pilots call the pursuit curve, you head for your special victim at right angles and turn in with him. This worked beautifully in the old days—five years ago. Even with today's jets it's all right at 35,000 feet. But try it at 40,000 plus and a small plane stalls in the thin air. That's because a sharp turn means slowing down. And when you slow down, your jet doesn't suck enough air—so you drop.

If you try creeping up on your target from behind, your superior speed lets you move right up. Forgetting his tail guns (as if you could), you wait for the range. Then he swerves sharply—but you can't. By the time, seconds later, you have come about, he is out of range—or even out of sight.

At upwards of 40,000 feet, I am told by those who have been there, seeing is not necessarily believing. Things look different. At this altitude, bombers have been sighted 70 miles away by their vapor trails—in clear weather, of course.



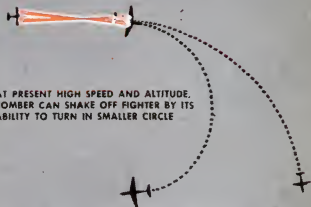
AT LOW SPEEDS,
FIGHTER COULD
MANEUVER TO
KEEP GUNS
TRAINED ON
TARGET



AT FORMER LOW
SPEED AND ALTITUDE,
FIGHTER COULD TURN
INSIDE BOMBER, AND
THWART ITS ESCAPE



LACK OF MANEUVER-
ABILITY AT HIGH
SPEEDS LIMITS
FIGHTER TO BRIEF
BURST OF FIRE AT
PASSING TARGET



AT PRESENT HIGH SPEED AND ALTITUDE,
BOMBER CAN SHAKE OFF FIGHTER BY ITS
ABILITY TO TURN IN SMALLER CIRCLE

With increasing speed and altitude, keeping fixed guns of fighter trained on target by maneuvering the plane becomes more difficult.

Comparative maneuverability of fighter and bomber has been reversed. Now the bomber, instead of the fighter, has the advantage.

TODAY'S FAST, HIGH-FLYING BOMBERS ARE HARD TO INTERCEPT

Bomber speeds on toward target while radar warning is relayed and fighter pilots scramble for take-off.

Still unmolested, bomber continues nearing target while fighter planes climb to its altitude of 40,000 feet.

Fighters have only brief chance to intercept bomber, and may miss it by even slight navigating error.



The problem of stopping the bombers, I learned, shakes down into phases. First, catch your bombers. That means getting the pips, like glimmering apple seeds, on a radar scope. Second, intercept the attackers with defensive aircraft at the attackers' altitude. Third, knock them down.

For the purposes of this article, I was told not to concern myself with detection or interception—no mean feats at the altitudes and speeds of our own best bombers. I was told to confine myself to the ultimate solution of that final phase: knocking down the bombers once discovered and confronted.

When I had talked to the last expert, I could not answer flatly that fighters were finished, that bombers had become invincible.

But I can say, as a reporter with no pretense to being a military or aviation expert, that *the best existing fighters have an awfully bad time trying to cope with the best existing bombers—based on available statistics of performance.*

It is a fact that a good big airplane now can get away from a good little airplane. But it is not a fact that the best big airplane cannot be stopped. And there simply are no facts whatever concerning a conflict between large numbers of airplanes.

New Fighters Sure to be Bigger

We do know that visual shooting is almost obsolete. High altitudes and high speeds make airborne pistols seem silly.

We do know that some of the newest fighters are as big and heavy as some not-so-old bombers.

We can suspect that normal evolution will bring forth a defensive airplane big enough to carry detection equipment, fire-control equipment, long-range weapons, and the crew to man such a plane and such gear.

What kind of airplane will it be? The name isn't important. Call it a fighter-bomber. Or call it a superfighter. It won't be as big as a bomber like the B-36, but it will almost certainly be bigger than the fighters now operating, and it will have to cut the corners closer, climb fast, and catch up quick. And then what?

You can be sure that mere machine guns, or even fast-firing cannon like the 20-mm. artillery on the B-36, won't be up to the job. Even unarmed bombers could fly through such short-range fire with small chance of a vital hit. The best airborne boom-boom is about as effective as a



Newest U. S. fighter to challenge bombers is one above—the needle-pointed, twin-jet F-90.

drunken cowboy's six-shooter on woodcock.

Rockets? They have the punch, all right. But they have to be fired within a visual distance—dangerously close—and by aiming the airplane.

The guided missile seems to be the only probable weapon against the big bombers.

Eventually, its proponents claim, the guided missile will make even airplanes obsolete. There will be no need for bombers when whole coveys of these deadly quail can be flicked from one continent to another. There will be no chance for fighters, either, when ground-to-ground missiles take over.

But in the next few years, there will be ground-to-air missiles hurtling toward their targets without pilots. And air-to-air missiles that need no human hand once set.

It is these air-to-air guided missiles that will most likely make the biggest bombers gone geese. The superfighters of the fairly near future will be submarines of the air.

Early-warning radar will alert these jumbo jets. Once upstairs, their own airborne radar will track them to intercept the big bombers long before they come into visual range. They will fire their missiles, as submarines fire their torpedoes, in calculated spreads.

Once out of the tubes, the missiles will speed toward their targets. When they get within range of the homing devices in their noses, they will change course to close with the moving enemy. Finally, the proximity fuses will take over.

In this interim period between the big fast bombers and the nation-to-nation missiles that need no pilots, bombardiers, or navigators, the main problem of the defensive air force will be to provide a lot of flying killers—of types more dangerous to their flying prey.

Designers are working to meet these specifications. One hope is a jet engine to operate more efficiently at high altitudes. Another is adjustable wings. You can get more speed with either a small, conventional wing or a

(OUTLINES SHOW COMPARATIVE SIZE
RULED SQUARES ARE 10 x 10 FT.)

50 FT.
40 FT.
30 FT.
20 FT.
10 FT.
0 FT.



Evolution of fighter plane from 1918 to 1949 is shown in these silhouettes. F-90 measures

55 feet long, has 40-foot span, and is designed to fly at approximately the speed of sound.

swept-back wing that looks like the head of an arrow, but when you slow down to maneuver, you may stall out. So why not build a wing whose area or sweep can be altered while in flight? Can do, say experts of the National Advisory Committee for Aeronautics.

Then there is a gadget designed to give a jet a swift kick in the tail. It's called an after-burner (PS, Oct. '47, p. 82). It shoots a mixture of alcohol and water into the engine's tailpipe, thereby speeding up the gases that rush out of the end and shove the plane ahead. The AF's F-88 has one of these; also the Navy's F7U, the Cutlass, now in production and designed to do at least 650 m.p.h. even above 40,000 feet.

But all the climb, speed, and maneuverability in the world won't help the fighter unless it can find the target in any sort of weather. So a lot of research work is going into improving airborne radar.

We'll still need early-warning ground radar, too; but, as a Pentagon officer put it, "A bomber crossing a radar-guarded frontier is like a fly zipping through the front door of a big hotel. Anybody can see the darn thing enter, but how are you going to tell what room he's headed for?"

Then—most important of all—that quick knockout punch. For even with all the climbing ability and speed he'll be packing, the pilot will have precious little time for sparing around.

Tomorrow's superfighters will have to be flying *weapons*. Primarily they'll have to be thought of, not as planes, but as platforms to carry the biggest possible punch to the place where it will do the most good.

That's one of the reasons the Air Force is setting up a center at Eglin Air Base to test air-to-air and air-to-ground weapons—and the instruments needed to guide them. Aeronautics research people expect the effectiveness of existing weapons to be perked up considerably by an automatic

aiming mechanism. This will be a combination of radar, to track down the bomber, and a computer to figure such factors as relative speed and course.

But, the planners say, the only sure answer to a fighter's need for a quick, lethal blow is the guided missile. Eventually it will be the job of radar ground crews not only to detect approaching bombers but also to send pilotless missiles against them. First, though, long-range accuracy must be perfected.

Short-range accuracy, on the other hand, is relatively simple to achieve. Once we've got it, all we need is a suitably placed launching platform. The earth won't serve because it's too far away from the bomber, but a fast-climbing fighter will do nicely.

Radio Could Guide Missile

The simplest guided missile is controlled by radio, which means that the operator must be able to see both it and the target either with his own eyes or through radar. For the job at hand, however—knocking out a bomber that may be shooting at almost sonic speed through black or murky weather—the fighter's best bet is a missile that, once launched, needs no human control. Carrying its own gray matter, it seeks out the target with the instinct of a homing pigeon.

Such a bloodhound of the air has a sensing mechanism—commonly called a scanner—built into its nose. One type is sensitive to light; it locks onto and follows a source of light the way moths follow a lamp moved around a room. It can be made to sniff out an opaque object moving against a background of different density.

Another type can track down anything that makes noise. A third responds to heat: enter a huge hangar where a heat-scanning head is stored, and the warmth of your body is enough to make it follow you no matter how fast you turn or side-step. Still another—perhaps the most useful in this case—navigates like a bat, sending out

silent sound waves that obstructions reflect.

No matter what the type, the missile follows its sensitive nose to within lethal distance of the target, where a proximity fuse sets off the explosive-packed body.

By the end of World War II we were already producing such homing weapons (PS, Feb. '46, p. 84). Most of them were designed for use against ground targets and ships, but it takes no miracle of ingenuity to fit them for work against bombers, as well. Says General Joseph T. McNarney, chief of the Air Materiel Command: Their development into operational missiles "will take only a relatively short period of time."

You can't put radar, and somebody to run it, or an auto-pilot to take over the controls while you run it, and mechanism to control adjustable wings, and automatic sighting devices into a fighter the size of those operating today. Planes carrying guided missiles will change some of the specifications: they won't have to get so close to the target and they won't have to be so maneuverable, but they will need something else—stability. Unless they are to be one-shot weapons, they will have to be pretty sizable.

The trend has already set in. The Navy's Banshee weighs only 14,000 pounds and the

Air Force's F-84, 15,000. But the Cutlass, now being turned out, weighs 22,000, and the XF-90, now being tested, 3,000 pounds more. *The last-named "fighter" is both heavier and longer than the "bomber" Jimmy Doolittle used against Tokyo.*

The end is not yet in sight. Conceivably the fighter plane of the future could be much like a plane we already have, the B-47, a jet-powered bomber that recently whizzed from Seattle to Washington, D. C., in three hours, 36 minutes. Its weight is 125,000 pounds; speed, 600 m.p.h.; climb, 5,000 feet a minute; ceiling, 38,000 feet. It's big enough to carry plenty of radar and a covey of guided missiles.

Eventually, scientific and engineering developments will make both the bomber and the fighter obsolete—maybe civilization, too. But first they seem destined to produce better and costlier fighters than ever.

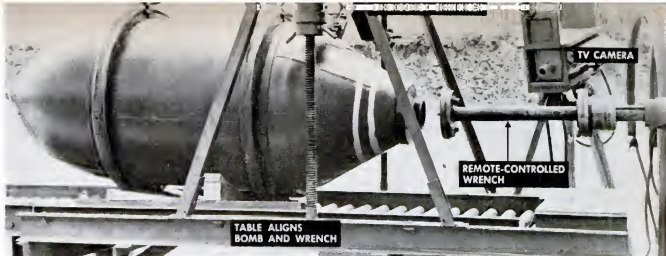
To keep ahead of the fighter, the bomber will have to do some terrific humping. But don't pin your hopes for safety on defensive armament. From the last war came this clear lesson: when a bombing attack has once been launched, no human force can stop *all* the planes. Some, at least, will carry out their mission. END



New Lifeboat Launcher Speeds Sea Rescues

SWINGING down like a drawbridge, this new Coast Guard lifeboat launcher (left, above) gets a fully manned boat off the deck and into the water in five seconds—from 25 seconds to two minutes faster than

old-type launchers. Designed to speed rescues at sea, it supports the boat in a cradle on two booms that can be lowered by one man. As the boat strikes the water (right), the cradle drops lower to clear it.



TV Helps Pull Bomb's Fangs

IF THIS 4,000-lb. bomb blows up while its booster is being removed, the only casualty will be the Remington Rand Vericon® tele-

vision camera. It is transmitting the scene to a screen in an explosion-proof barricade a safe distance away, where an Army Ordnance technician operates remote-controlled electric motors that do the job.



Magnets Aid Yachtsmen

YACHTSMEN can visualize a boat-handling problem easily with the aid of this special demonstration board. It is simply a piece of sheet steel on which cutouts representing ships, docks, wind-direction arrows, etc., are held in any desired position by tiny Alnico® magnets fastened to their undersides. The Cleveland Power Squadron built this one.



Spark Plug Reduces Static

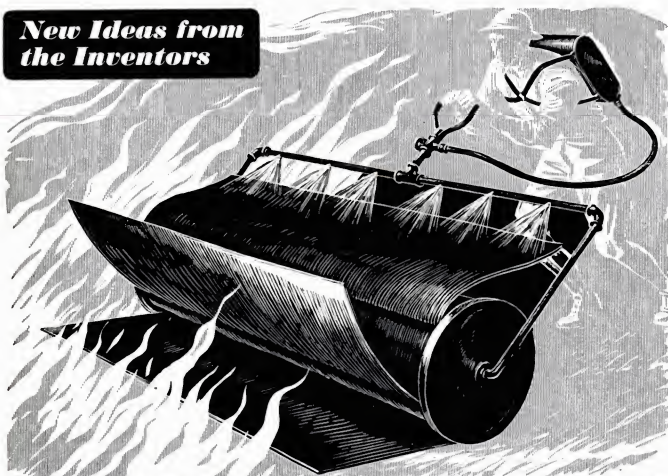
POWER-CRUISER owners won't be bothered by engine interference with radio-telephone, radio, and television operation if they use this new spark plug, reports the Electric Auto-Lite Co. It has a built-in, 10,000-ohm, carbon resistor, shown above, that cuts down the high-voltage variations causing the static. Similar plugs are available for cars.



Monitor Guards Atom Workers

THIS machine, which looks like a penny-in-the-slot scale, checks on the "cleanliness" of atom workers' hands and feet. The worker merely sets dials, steps on the platform, and sticks his hands in the holes. Geiger counters measure the radioactivity while a pen records the amount. Paper bags lining the hand holes and a paper sheet under the foot platform are thrown away after each use to keep "hot" dust out of the works. The device was designed at the Hanford plutonium plant and is made by Kelley-Koett Manufacturing Co., Covington, Ky.

New Ideas from the Inventors



"Paddle Wheel" Puts Out Fires.

This novel fire-fighting apparatus is designed to extinguish brush fires by beating them out, as in the old broom method. As the big roller is pushed forward, flexible

mats slap the ground one after another, smothering the fire. Spray jets along the top keep the mats wetted down with water or chemicals from a back-pack tank. The inventor is P. H. Murphy, of Helena, Mont.

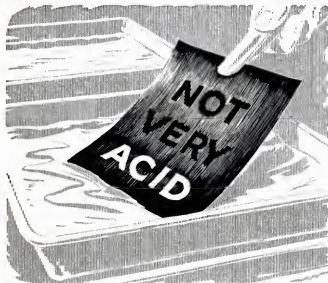
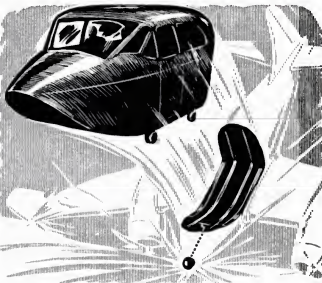
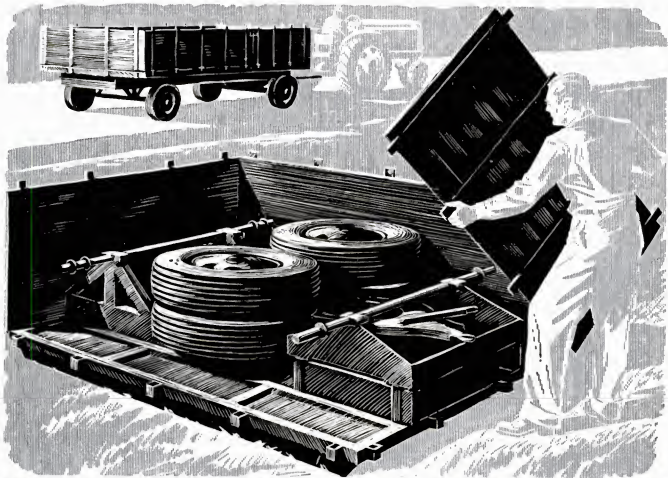


Photo Aid Tests Stop Bath. If a photographic stop bath is acid, this red-dyed paper indicator blackens, and the word "not," printed in black, disappears. As the acidity dwindles, the paper returns to red, the "very," in red, vanishes, and the black "not" reappears. The inventors are J. Crabtree and H. Russell, of Rochester, N. Y.



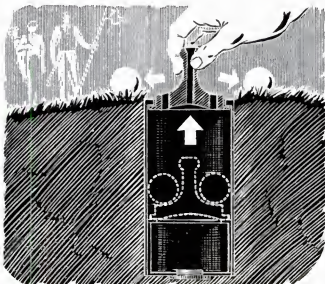
Crash Releases Plane Cabin. If this airplane crashes, a plunger in the nose releases the detachable cabin so it will be thrown clear of possible fire or explosion. Two curving tracks in the fuselage guide the wheeled cabin and give it an upward toss to make sure it lands well ahead of the plane. Inventor is F. Reed, of St. Paul, Ind.



Trailer Packs into Own Crate.

This trailer can not only be taken apart and packed up in a crate, but it even supplies its own crate. Its floor folds up to form one end and the bottom of the crate, while

its sectional walls fit together to make the sides and top. The underframe telescopes together, fitting inside the crate along with the wheels and axles. J. H. Stark, Jr., of Springfield, O., invented the trailer.



Golf Balls Lift Out of Cup.

You wouldn't have to fumble in this golf cup to retrieve balls. Just pull up the lifter in the bottom, and its sloping sides roll the balls right out onto the green. A hole in the handle holds the marker staff, while others let rain water drain through. The inventor is D. Matheny, of New Brighton, Pa.



Kiddy Car Makes Car Seat.

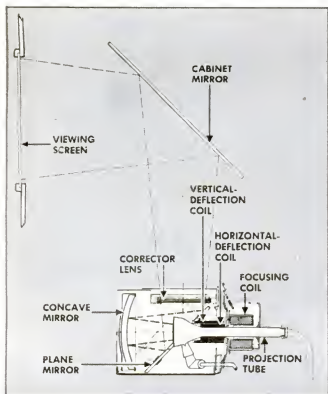
Junior could ride this kiddy car even on auto trips. The underframe comes off and folds up for easy storage, while the steering wheel tilts back so he can hold it. The turned-down flange on the rear hooks over the car seat to keep him from sliding. Inventor is F. White, of Bound Brook, N. J.

New TV Sets Project Pictures

A PACKAGED projection unit made by North American Philips Co. is being incorporated in current models by more than a dozen manufacturers of home television receivers. Some of these new models will throw the video picture on a screen outside the unit, just like home movies. Main components of the Protelgram® are shown in the photo at right. The optical system is diagrammed below.

A 2½-in. picture tube, whose face is a lens as well as a fluorescent screen, forms the heart of the unit. A 25,000-volt power supply produces a picture of high brilliance on the tube face. The image is reflected by a concave mirror and another tilted at 45 degrees. Spherical distortion is removed as the image passes through a correcting lens.

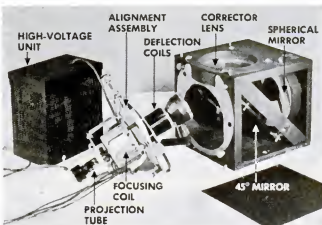
The projector is a modification of the Schmidt-type optical system. Most of the receivers in which it will be used will employ 12- by 16-inch viewing screens in the cabinet; a few will use the projector to throw a three- by four-foot image onto an external screen.



"Folded" Schmidt optical system beams picture onto concave mirror. Corrector lens and two angled mirrors put it onto viewing screen.



Image is thrown onto an external screen by the Ansley Tele-Movie®. Optical system is similar to unit shown below. Set costs \$795.



Protelgram® consists of power supply, left, and projector employing 2½-in. tube. Each set maker designs his own receiver chassis.



Cabinet type of projection set will be most common. In some the viewing screen folds into the cabinet. This Fisher model sells for \$795.

How to Spend \$200,000 on One Automobile



Money spent up to now on this designer's dream would purchase 100 medium-priced cars.

Restyled and re-equipped countless times, Packard's "dog" car is a changing parade of automotive progress.

By Devon Francis

PS photos by W. W. Morris

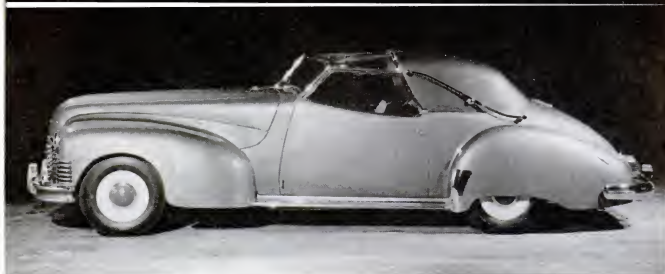
PICTURED on this and the following two pages is the most expensive car in the United States. Up to now it has cost around \$200,000. The man who drives it is Edward Macauley, chief stylist of the Packard Motor Car Co. He has been offered \$50,000 for it.

When Packard thinks up something new in equipment or styling to put on its automobiles, it first tries it out on a "dog"—and the "dog" is Macauley's machine.

The car has been restyled, rebuilt, and re-equipped so many times that Macauley, son of Alvan Macauley, former president and board chairman at Packard, has to refresh his memory from photographs to recall what it looked like years ago. That's what makes it so expensive.

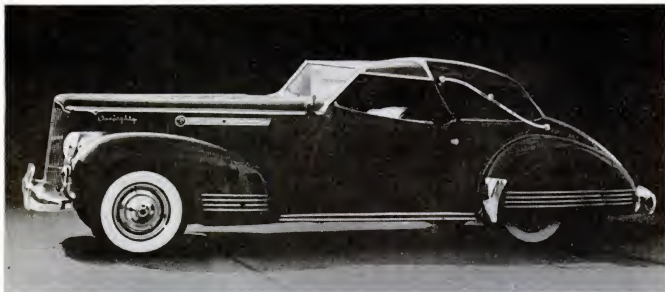
The grillwork that the company has put on its production cars for the last two years was first tried out on the Macauley car in 1940. The bumper on the 1948 Packard was first used by Macauley. He has tested scores of other items, including liner springs, that were adopted for production.

At one time, the dog car actually contained a 500-lb. refrigerating unit, to cool its occupants on hot summer days. ➤



1944 version of Macauley's "dog" car had separate, well-defined fenders instead of long, continuous ones on present version shown on previous page. The hood, grillwork, and bumpers,

however, were similar. Note one-piece, nearly closed rear fenders. Special hood is 13 inches longer than standard Packard design, creating racy appearance but cutting down visibility.



Original version, as it appeared in 1940, combined sleek, rakish lines with traditional Packard hood and grille design. Individual fenders were similar to those on later, 1944 version (at top),

except that rear ones were open type covered with fender skirts. The car, called "Brown Bomber" because of its present golden-brown finish, is known officially as "The Phantom."

Macauley likes to drive something snappy, so he ordered the car's general configuration when the machine was first built nine years ago. It has a standard chassis and engine. Once, it contained a 12-cylinder engine and on one test clocked 128 m.p.h.

Some of the things Macauley has added to the car are merely for his personal comfort and that of his wife. The right front seat reclines, for instance, so Mrs. Macauley can take a nap on long trips. Vanity compartments in the side walls accommodate mirrors, lipsticks, and powder puffs.

The car invariably draws crowds. When it was driven to Detroit's Belle Isle to have its portrait made by POPULAR SCIENCE, passers-by collected in such numbers that the PS photographer had to spend half his time shooing people away.

Its owner can't park it on the street. It stops traffic. He always has to put it in a commercial parking establishment—preferably a dark corner of a garage.

Macauley has arrived at some firm conclusions as a result of driving his dog car. One of them is that plastic tops, regardless of their color, are just too hot in the summer. Another is that fog lights, at anything above the bumper level, are useless, and that the color of the glass in them has nothing to do with their penetrating qualities.

He also concludes: "This car proves that all styling in the automobile business is evolutionary."

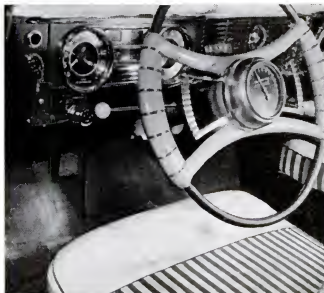
Take a good gander at the machine as it looks today. It's always undergoing changes, and it probably won't look this way by the time the snow flies.



Long, sloping doors are push-button operated and extremely heavy. Hydraulic windows are remote-controlled. Other refinements include air brakes, reclining front seat, and center armrest.



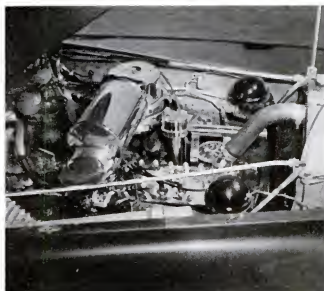
Transparent sun roof over front seat has been retained throughout all versions for experiments in filtering sunlight with different-colored plastics. Rear part of the car's top is solid steel.



Special equipment includes extra-loud highway horn (white knob), tachometer, barometer, altimeter (on steering-wheel hub), light that glows red when oil pressure drops or water overheats.



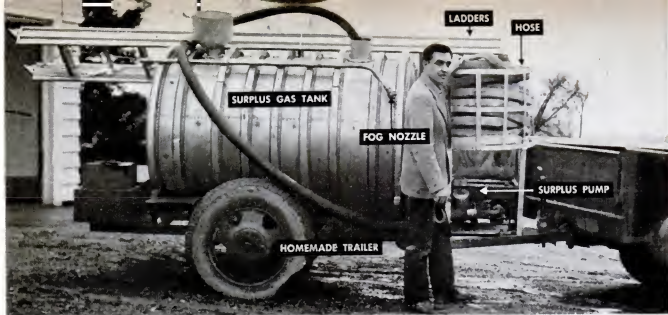
Large, roomy drawer was substituted for conventional glove compartment. Cowl shoulder is covered with pale-yellow plastic. Dash controls include transmission lockout and engine blower.



Snazzy, chromed engine is standard Packard eight. Car weighs 5,800 lb., averages 15 miles per gallon, is now equipped with Packard's new Ultramatic Drive® (PS, June '49, p. 139).



Trunk lid raises hydraulically; so does radio aerial to its right. Inside are fire extinguisher and compressed-air cylinder for filling flat tires. The eight-stack exhaust pipe is just for looks.



Salvaged Fuel Tank Makes Rural Fire Fighter

A SURPLUS aircraft fuel tank mounted on a homemade trailer now provides extra fire protection for the rural areas around Lapeer, Mich. Towed by a light truck, it can fight blazes all alone—it carries 470 gallons of water, a motor-driven pump, hoses, ladders,

and other equipment. Or it can assist other fire apparatus, pumping water to trucks from its tank or from a stream. The unit, built from used parts, cost under \$1,000, reports designer Bob Myers, and carries as much water as a \$10,000 fire truck.



Hoe Does Day's Work in Hour

THIS new British rotary hoe, which has a four-stroke, single-cylinder motor and self-sharpening blades, can prepare seed beds in a single operation—a day's hand work in one hour. The blades not only lift, break up, and aerate the soil, but mix it with cover crops, fertilizers, and manures. The hoe is manufactured by Rotary Hoes Ltd., of Essex, England, and is now being tried out in California.



Flag Says Stop the Water

THIS device waves a flag at you when the lawn has had enough sprinkling. The flag is held down by a metal probe sticking into the ground. When moisture soaks down to the probe tip, it loosens the soil enough to release the probe, which in turn lets a spring push the flag up. The depth you push in the probe, which measures water depth, can be varied. Garden Specialties Co., Chicago, makes the Moistr-Meter®, priced at \$1.50.

The Best Seat in the Ball Park



Among those who know, it is generally agreed that baseball is the toughest sport for the television cameras to cover. Here is the story of how they bring the National Sport right into your home.

Television's baseball team puts your easy chair right up behind home plate for a bird's-eye close-up of the game.

By Herbert Johansen

PS photos by Hubert Luckett

PLAY ball!

Johnny Pesky, up for the Boston Red Sox, steps into the batter's box.

Lefty Joe Page, on the mound for the New York Yankees, goes into his windup for the first pitch.

Cameraman #2, up in the press box behind home plate for the television "team," trains his wide-angle lens on the scene below.

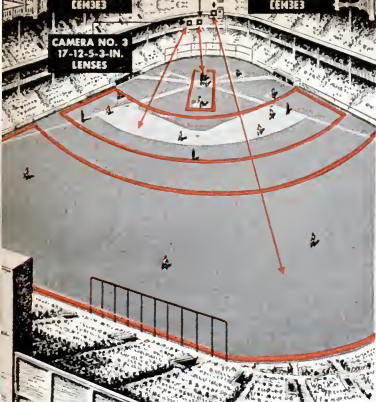
There is a sharp crack of bat against ball. All three teams go into action.

While #2 camera follows the spinning

ball, its #3 twin in the press box picks up the running Pesky, ready for a close-up at first base if he makes it. But it's a long hit to the outfield! That's the job of #1 camera from its vantage point in an upper-tier "basket." Its telephoto lens picks up the fielder as he runs back—nails him as he makes a sensational catch right in the stands.

Meanwhile, #3 camera sweeps the cheering crowd in the stands, then "pans" to pick up the next batter as he walks out swinging a couple of bats. And #2 camera has shifted back to its main job of covering the pitcher-batter for the play coming up.

What you see on the screen of your television set at home is a rapid-fire selection of the best of these three images, resulting in a smooth continuity of action. And as you will notice from the diagrams on the following pages, the three cameras that play television baseball bring you the game's ▶

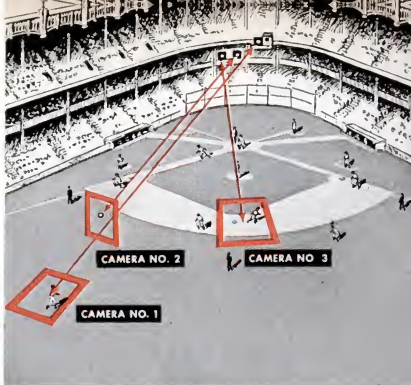


The main job of each of the three television cameras is shown in drawing above. Outfield is covered by #1 camera's telephoto lens; the pitcher-batter by #2, and the infield by #3.

action from one viewpoint. The effect of their coordinated "play" is to project your easy chair into space behind and above the home plate—giving you the park's best seat.

If you watched television baseball in the past years, you may have noticed a jumping around that gave you the jitters. You would be looking at a play from behind home plate. Suddenly you were shifted around to behind third base. Before you could orient yourself, the same play came on the screen as if you had been sitting in still another part of the stands. It was something like watch-

The upper-tier television "basket" during a scene of activity. This is the location of camera #1. At far right is the sound-catching "parab" reflector. Man at top is radio broadcaster.



Here the #2 TV camera follows a ball hit to the outfield, while #1 camera is trained on outfielder running in for the catch. Camera #3 was on man at 2d base and follows him as he runs to 3rd. Camera #2 will then shift to pick up runner at 1st base, ready for close-up.

ing the game through a big kaleidoscope.

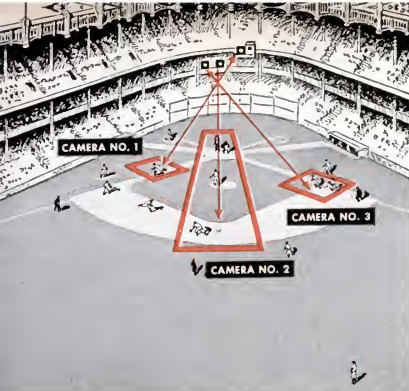
That, decided Harry Coyle, young director of mobile operations for Du Mont's WABD and manager of its television "team," isn't the way a fan at the park watches a ball game—or would want to.

"He may jump up and down in his seat as his blood pressure rises," says Coyle. "But he doesn't dash madly from one side of the stands to the other as the action shifts on the field. He stays put—more or less. So why shouldn't television do the same?"

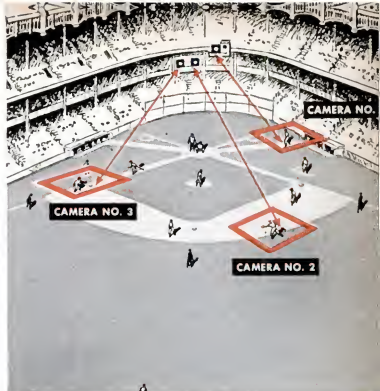
That's why Coyle eliminated his camera

Other two "eyes" of the triple television seat are located in front row of the press box, behind home plate. The cameras are electronically controlled from booth shown on the next page.





In this situation batter has hit a blistering grounder to 2d base. Camera #2 has followed the ball, while #3 camera covers man at 3rd base in case he tries to score. Meanwhile #1 camera has swung from the outfield, ready to catch a possible close play at 1st base.



A hit to shortstop is picked up by camera #2, which then follows a throw to 1st base. Camera #3 already has followed runner and gets close-up on the put-out. Camera #1 picks up next batter coming out of the dugout, and holds him until #2 camera comes in with wide-angle lens.

behind third base and grouped them all together behind and above home plate for this year's telecasts of the Yankees' home games. But that doesn't mean the new technique limits the field of coverage. It lets the viewer see just as much, but without the confusion.

Each swivel-mounted camera has a turret of four versatile lenses that can be instantly shifted by a push button from a wide-angle sweep of the entire field to an intimate close-up of hot arguments among umpires, players, and managers. While each cam-

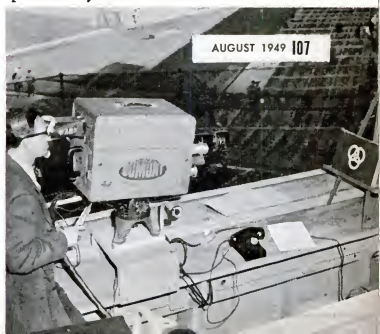
era has one main job, all double in brass.

Behind this camera battery is the rest of the television baseball team. Squeezed in with camera #1 in the upper-tier basket is the announcer, the man who adds rapid-fire words to the pictures. He not only must watch the action of the field, but he must keep part of one eye fixed on the screen of a small television set in front of him so that he knows what scenes are going out over the air. If he didn't, there would be times when he excitedly described one scene but your TV set showed something else. ▶

Control booth is the nerve center of a baseball telecast. The director, far right, watches monitor viewing scopes and selects the image that will be transmitted to the television audience.



Here one press-box cameraman aims lens at a commercial trade-mark. The ring image will be superimposed on image of the playing field provided by another camera.



This works both ways, and mostly the other way. You may be sure that the man at the television mike knows his baseball and is describing the action and color the man on the receiving end wants to see and hear. So the director, who selects the image that is going out over the air, keeps his ears tuned to a loudspeaker in the control booth. In many cases he will order a camera pick-up switched to illustrate the commentary.

Recently a telecast announcer describing a fly ball going into the "teeth of the wind" remarked, "it's too bad there's no way of showing you folks the whale of a wind we're having here at the Yankee Stadium today."

That was the director's cue. He got his #3 cameraman on the interphone and told him to shoot to the flags on top of the stands with a telephoto lens. Then he ordered the resulting #3 image on the air. The viewing audience saw the pennants standing straight out and practically felt the wind the announcer had described. The announcer, not aware of what was being done until he saw the flag image on his television set, fell into line and said, "You see what I mean about the wind?"

It was only an instant flash, a few words, then back to playing baseball. But it's that kind of local color that makes the guy at the screen end of television 50 or 100 miles away feel that he's right in there with the fans, missing nothing.

Sound Is Important, Too

Elbowing the announcer in the basket is the audio man. His job is to see that you get the announcer's running account of the game, the crowd's roars, the between-inning interviews, at just the right sound level. In his charge is the "parab" sound-catching reflector that brought in that crack of bat against ball. At times it also picks up certain brickbat language that he must muffle before it hits the air waves and the tender ears of young baseball telenthusiasts.

Now we go into the television team's "dugout"—the control room behind the upper tiers. That's where our umpire sits, the director who decides what picture is sent out to your screen.

In front of him are three viewing scopes, one for each camera, and their electronic control panels. At the far left is a fourth unit and scope that shows the picture he has selected and carries it to the transmitter.

At the same time the director is listening to the announcer's commentary on the loud-

speaker and analyzing it instantaneously picturewise; keeping tabs of the viewing scopes, judging them for clarity and continuity of action, and from time to time phoning instructions to the cameraman to "open that iris" for a better image or "get back there in the right outfield" for a play he has a hunch is coming up; eyeing a television screen up in one corner to see whether his pictures are going out over the air or if a film commercial has been cut in from the studios downtown.

After one WABD telecast, Du Mont's Harry Coyle mopped his brow and agreed heartily that baseball is tough to cover.

"Why?" we asked.

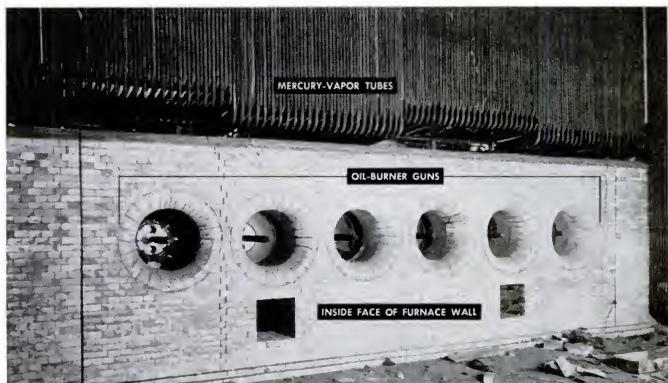
"Well," he explained, "mainly because the action is not concentrated, and there is so much of it. And to make it tougher, you can't anticipate what will happen as in football and basketball.

"It's the unexpected that keeps you on your toes. A guy who hits out to right field nine times out of ten suddenly fouls you up by smacking one way out to left field. The bases may be loaded with two down and you get set for a routine third out. Then up come a couple of errors, and the ball and everybody are all over the place. Double steals are dynamite if you're napping—which you aren't. And," he sighed, "if only they played baseball with a basketball or football instead of with a pill."

On guard at the three monitor panels are two video men on the alert for electronic errors. Their main interest is not so much in the viewing screens as in the small, jumping oscilloscope patterns. Just as the audio man adjusts sound levels, the video experts adjust light levels. By twisting dials and turning knobs they also control the electronic insides of the cameras. The fourth monitor is the switcher, tended by an engineer who flips levers to pick up the image selected in running order by the director. He also has final control over light levels before the picture goes to the transmitter.

This year the rooting roars of armchair and tavern television fans are louder than ever. All major-league home games are being televised except those of Pittsburgh—and those not for the lack of television facilities but for the lack of a sponsor.

Come the World Series, the bet is that it will be on the television screens—the bet being that sponsor money will be paid out to reach the "best-seat-in-the-ball-park" audience. The TV team will be ready. **END**



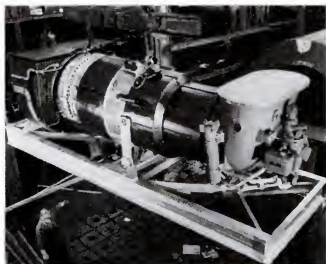
Flame's-eye view shows inside of mercury power plant replacing pioneer Connecticut set-up.

Inside View of Mercury Boiler

You see a rare view of a rare piece of equipment in the photo above. It shows the oil burners and tubes of a boiler that uses mercury—the silvery liquid metal found in good thermometers—instead of water. The mercury is vaporized in the tubes and

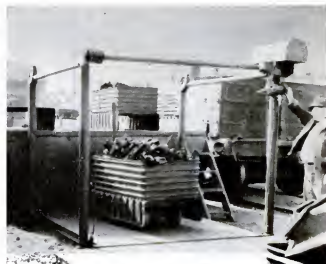
then turns special turbines. When it condenses to a liquid again, it gives up heat to make steam to drive other turbines.

The occasion for this inside peek was the erection of a new, 15,000-kilowatt GE mercury plant at the Hartford Electric Light Co. It replaces a smaller installation—one of the first ever built—that had run 19 years.



Gas Turbine to Make Power

HOMES around Oklahoma City will soon be lighted by electricity generated by gas turbines—the first such installation in the U. S. The 3,500-kilowatt GE turbine (above), similar to the power plants now used in some experimental locomotives, is to supplement steam generators at a station of the Oklahoma Gas and Electric Co.



Elevator Loads Freight Car

ONE man can now load heavy material into freight cars with a small elevator to do the lifting for him. Able to operate in spaces too cramped for a crane truck, it raises a three-ton load with a one-hp. motor. It has a platform 8 ft. long and 6½ ft. wide. Service Caster and Truck Corp., of Albion, Mich., makes the Leveler®.

HOW TO TAKE MILK APART



Way to retain flavor of fresh milk while drying it has eluded researchers until development of present processes and equipment. First of the steps, indicated in drawings above, is removal

and purification of butterfat with high-speed centrifuge and settling tank. This gives yellow, honey-like butter oil, which is sealed in cans with nitrogen gas. The remainder is skim milk.

Mechanical Cow Serves Global Milk Route

Splitting milk solids into fat and skim powder permits later recombining with water without harming taste.

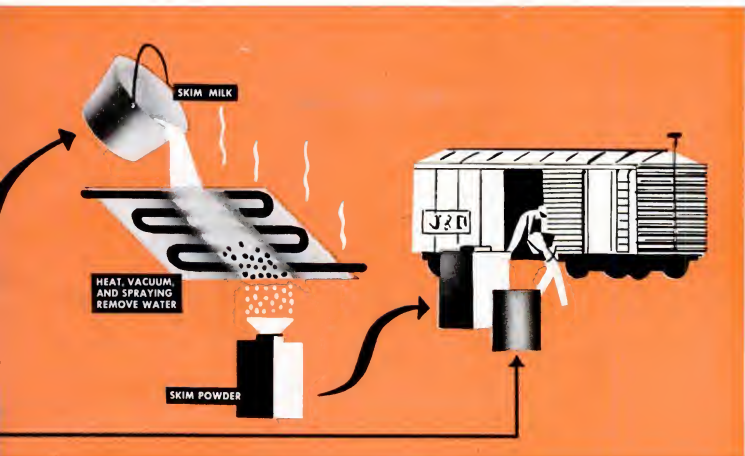
By Martin Mann

Drawings by Jere Donovan

GIs in the Pacific are now drinking milk from cows that don't moo—they clank. These new mechanical cows produce pasteurized, homogenized, grade-A milk that only a calf can tell from the original. And a quart costs no more, maybe less, than the ones you buy from the corner grocer.

The postwar-model mechanical cows are providing pure, tasty milk in places with little or no local supply. In the Far East, the American soldier's thirst for milk is being slaked by seven machines making 22,700 gallons daily—equivalent to a herd of 7,500 live cows. Any surplus goes to native kids. One strictly civilian plant is now running in Haiti (unlike the GI plants, it uses coconut oil instead of butterfat, to cut costs). And others will shortly be supplying the milk-thirsty citizens of the Philippines, Venezuela, Trinidad, Curacao, and Aruba.

All this is possible because a way has finally been found to take the water out of milk before shipment and put it back again at its destination—without affecting the taste. Until recently, no one had been able to do that trick. There was lots of powdered milk—the Army shipped tons of it to troops



Dehydration of skim milk is second step (above, left). To avoid "cooked" taste when ingredients are recombined, water must be removed very carefully. Milk is heated very

quickly in a vacuum, evaporating biggest percentage of water. Then it is forced through tiny holes to complete the drying operation. The resulting skim powder keeps without ice.

overseas during the war. But chances are that anyone who tasted it will wrinkle up his nose at the memory. The new stuff, its makers report, tastes just like milk straight from the cow.

There are several tricks to protecting the flavor. First, it's not enough just to evaporate water from milk, giving whole-milk powder; you must separate the butterfat from the milk and then evaporate the water from the remaining milk solids. Next, the evaporation itself must be done with extreme care, quickly, under vacuum, with little heat, to avoid the "cooked" taste typical of the older powders.

Many of the details of the process that gets milk from a Stateside cow to a Japanese glass are trade secrets. However, Dr. Charles E. North, who himself has invented many of the methods and machines used, outlined for *POPULAR SCIENCE* the general procedure followed at his pilot plant in New Paltz, N. Y.

There the first step is removal of the butterfat. This is done in machines like souped-up cream separators—huge high-speed centrifuges that spin the milk at

18,000 r.p.m. The butterfat is then put in special tanks, where curd and other impurities settle out. The result is a clear-yellow, honey-like material that is as close to 100-percent butterfat as laboratory analysis can determine. This "butter oil" is sealed under pressure of nitrogen gas in metal cans. Packed that way, it stays fresh indefinitely without refrigeration.

The skim milk left after removal of the butterfat is next dried. It is evaporated to one-fourth its original volume in a vacuum with as little heat as possible. Then pressure of 2,500 pounds per square inch forces it through a nozzle, creating a spray that causes the rest of the water to evaporate.

The dry skim milk and butter oil can then be shipped any place milk is needed. There—unlike Humpty Dumpty—they are put back together again with pure water.

In a typical recombining plant, such as the one the International Dairy Supply Co. operates for the Army in Yokohama, workers feed the skim powder into an agitator tank, where it is mixed at great speed with the correct amount of water. (Since the water previously removed was H_2O ▶

HOW TO PUT MILK TOGETHER



Recombining process reverses dehydrating operation, but uses, for most part, standard dairy equipment. In first step (left), skim powder is mixed with correct proportion of dechlorinated,

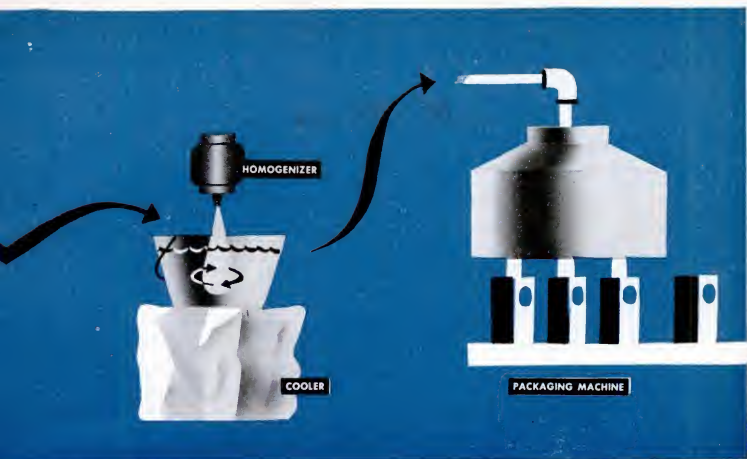
demineralized water to recreate original skim milk. This mixture is piped to pasteurizing vat (right), and melted butter oil is added. Vat revolves while contents are heated to 143°F.



Milk powder from the States begins its way to a glass of milk for a GI in Japan as technician pours it from shipping tin into tank in which it will be mixed with pure water.

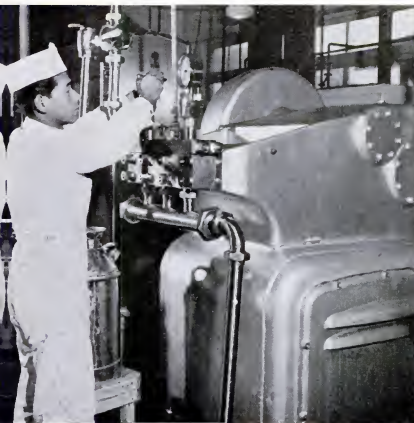


Modern pasteurizing equipment in Yokohama recombining plant has automatic recorders to keep track of process. These vats now contain mixture of skim powder and water plus the oil.

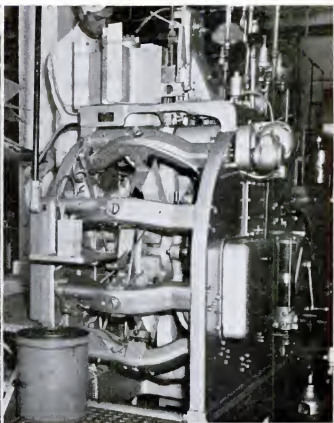



Standard homogenizer (above, left) insures that pasteurized milk is completely mixed, with all particles broken up, eliminating any danger of separation. During homogenization, temper-

ature of milk is reduced from 143° to 36° in 10 seconds. Milk is then bottled (right). Its looks, taste, and food value are now almost identical to those of the stuff that came from the cow.



With his eye on pressure gauge of homogenizing machine, Japanese technician adjusts process. These machines break up butterfat globules by forcing milk, under pressure, through tiny holes.



Packager puts American milk into American waxed containers in Japan. Machine can handle 65 quarts a minute. Plant is one of seven run for Army by International Dairy Supply Co. 



Regular tests of the recombined milk's purity, stability, and butterfat content are made by Japanese chemist. Civilian-operated, plants have Army personnel as resident inspectors.

and nothing else, the water put back must be just as pure, free of minerals, chlorine, etc.) A 500-gallon pasteurizing vat receives this mixture, plus melted butter oil, and holds it for 30 minutes at 143°F.

Next a homogenizer breaks up the butterfat particles, making smooth milk that cannot separate on standing. At the same time, the milk is chilled to 36° in 10 seconds.

To finish the job, standard packaging machines open up flattened cartons, seal the bottoms, dip them in paraffin, cool them, fill them with the milk, and close and staple them. Each machine turns out 65 quarts a minute. The entire process—mixing, pasteurizing, homogenizing, cooling, and packaging—takes less than two hours.

How does the "new" milk stack up against the genuine article? Most experts admit that nothing yet available exactly duplicates milk fresh from a cow. Yet, in a series of tests, 20 non-expert men couldn't tell the difference. And food values are identical: both have equal amounts of vitamins, calories, mineral salts, amino acids, and proteins.

Recombined milk is first being introduced on an extensive scale in places where local milk is poor or nonexistent—and that means much of the world. Dairy cattle can't take the climate of the tropics. Other sections, like Japan, are so overcrowded that good land is not available for grazing. A plentiful supply of wholesome milk in these areas

should help improve health, particularly among children. And American business men are not blind to the potential profits in a global milk route.

Here at home, plenty of good milk is available. Recombined milk will have to win a U. S. market the hard way—by furnishing a product that is as good or better at a lower price. Men like Dr. North, Grover T. Turnbow of International Dairy Supply Co., and Paul Jones of International Dairy Products Corp. think it can.

If this fresh-tasting milk were available in the U. S., they say, you might save as much as 25 percent on your milk bill. They estimate that recombined milk could be sold in New York City for 15 cents a quart. Fresh milk costs about 20 cents.

They point out that fresh milk is mostly water. In a gallon weighing nearly nine pounds, all but about one pound is just plain water. And since transportation expenses make up much of milk's cost, you must pay a lot of money to haul water.

Other factors add to the cost of fresh milk. Even under refrigeration it stays fresh only a few days. Hence it must be produced close to big cities—on comparatively expensive real estate—and rushed to the creamery in express trains of expensive, glass-lined, refrigerated tank cars.

Could Save Water Haulage

Recombined milk could reduce many of these expenses. There is no water to haul. Butter oil and skim powder stay fresh indefinitely—one sample of Dr. North's oil was stored by the U. S. Quartermaster Corps for nine months in a 100°F. test chamber without spoilage. It can be shipped in ordinary boxcars on ordinary freight trains. The dairy farms could be located wherever convenient, perhaps as far away as Australia or New Zealand, where production costs are about half those in the U. S.

The economies of the recombining process have already found it some uses in this country. Many restaurants and institutions make ice cream, cooking cream, and other milk products by this method.

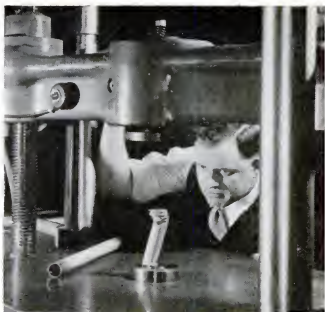
If recombined milk gains wider use, the dairy industry may concentrate far from population centers. Then children almost everywhere, like city kids now, would know live cows only from picture books. But that would be a small price to pay for the better health more and cheaper milk promises people all over the world.

END



Electric Fan Fits Pocket

BRITISHERS have thought up a new gimmick to help them stay cool—a battery-operated fan hardly bigger than a cigarette lighter. It has a tiny permanent-magnet motor inside the hinged cover, and a fan with two blades that fold together when the device is closed. Power is supplied by a standard, 4½-volt dry cell contained in the base. The pocket fan, called Don Quixote®, is made by the Arran Electrical Manufacturing Co., of London.



Plastic Coat Rustproofs Steel

A PLASTIC coat less than .002 in. thick protects steel tubing against rust better than galvanizing, reports the Jones & Laughlin Steel Corp., Pittsburgh. Their Perma-Tubing® withstood more than 2,000 hours of exposure to salt spray, compared to 24 hours for galvanized tubing. And as shown in photo above, it can be bent, expanded, flanged, fluted, or flattened without harm to the protective covering. The vinyl plastic is applied in two coats.



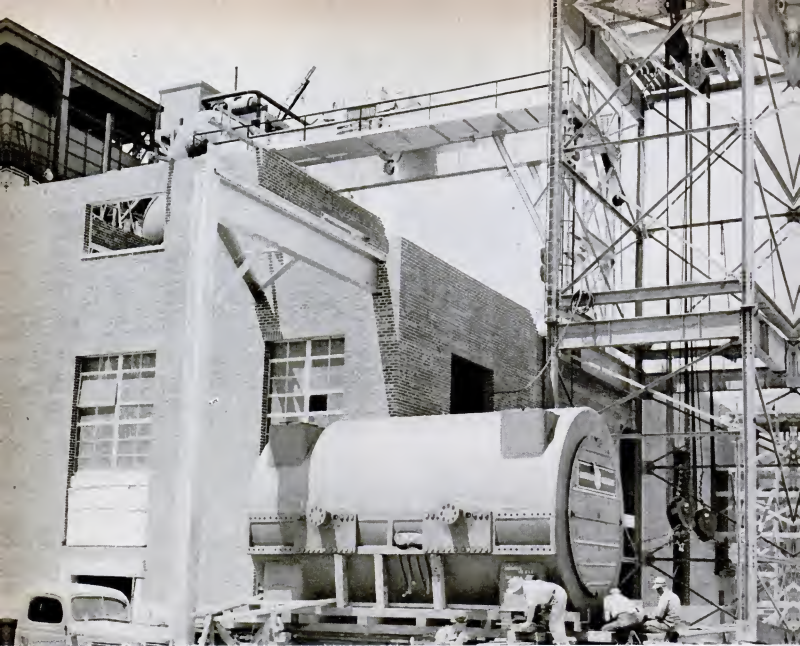
Car Heater Warms, Amuses

MORE than one kind of hot air comes out of this gadget. A car heater, it also contains a loudspeaker for reproducing the sound from movie film in drive-in theaters. Designed to hang inside car windows, it lets outdoor theaters operate when it's cool. Both sound volume and heat are adjustable, and the heat can be turned off in warm weather. Theatrecraft Mfg. Corp., Cleveland, makes the Mobiltone® heater-speaker.



Saw Cuts Casts, but Not Flesh

PLASTER casts are cut like butter—yet flesh can't be harmed—by a new kind of electric saw that eliminates the discomfort involved in removing casts with old-fashioned large shears. The blade in the Stryker Cast Cutter® makes short back-and-forth strokes 28,000 times a minute. These easily cut hard, unyielding materials like plaster, but do not affect soft materials, like flesh and cloth, which vibrate with the blade.



1 Destination of this 130-ton electric generator (tank in foreground) is the roof of the powerhouse at left. Workmen are getting ready to skid it into the special hoisting tower (right)

that will do the job. Upper and lower sections of the two-part, 65-foot tower can be seen bolted together at level of the roof. The hoist has a maximum capacity of 165 tons.

Tower Splits for Trick Lift

THE problem: How to get a 130-ton electric generator from a flatcar on the ground to its foundation atop a 30-foot powerhouse—and do it quickly. The Arkansas Power and Light Co., of Little Rock, solved it with a special two-part hoisting tower. Lifted to the top of the first 32½-foot tower section, the huge generator was at roof level. Then the upper tower section was unbolted, skidded laterally 30 feet to the rooftop bed, and the generator was lowered into place—all in seven hours.

4 View looking down on top of the powerhouse shows the steel skids in place, ready for the big side-slide of upper section of the hoisting tower, which still holds the generator.





2 Here the generator is shown in place in the hoisting tower, with lifting blocks attached. The workman on top of the tower operates two 20-hp. motors that do the lifting.

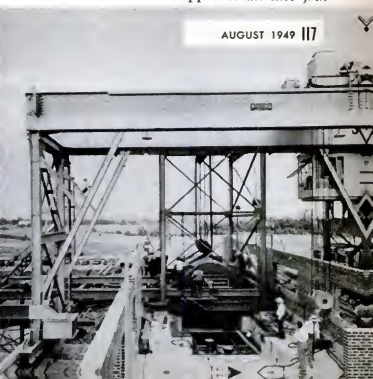
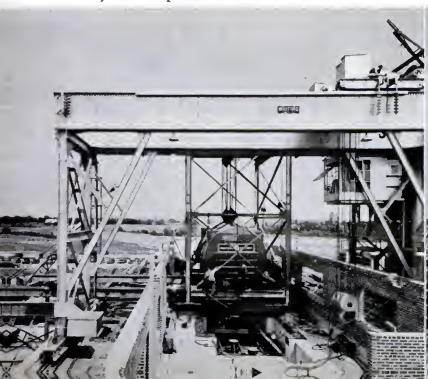


3 The generator is up in the air, even with the roof. Workmen are placing steel beams under top section of the tower, which will be unbolted and then skidded left across the roof.

5 After a 30-foot slide across the roof, the top section of the tower is ready to lower the generator to its rooftop foundation. A gantry crane pulled the tower across the roof.

6 With the big generator in its resting place, workmen are preparing to skid the tower top back to its original position. The tower then will be dismantled and shipped to another job.

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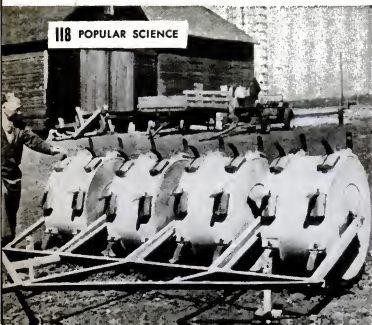
Flip-Flop Plow Aids Farmers

FARMERS can plow back and forth across their fields with a plow (above) that has two sets of shares and can turn itself over. An ordinary plow with one set of shares can go only one way because the shares turn furrows just one way—say to the right

—and would make a ditch or ridge between each strip. With the reversible plow one set of shares turns a furrow to the right, the other to the left. Thus it avoids plowing circles and then driving the heavy equipment out from the center over the plowed land. Made by Atlas Scraper and Engineering Co., Bell, Calif., it is flipped hydraulically.

Digs Holes to Catch Rain

PUNCHING holes in the ground is the latest method proposed to stop erosion. The Land Saver® below digs "pores"—28,000 per acre—as it is pulled by a tractor. These pores, claims inventor Homer K. Shonts, a Washington State wheat farmer, make rain soak into the ground instead of running into gullies and washing away priceless topsoil.



Hoist Gives Driver Free Ride

THE truckman gets a free ride on the new hydraulic lifter shown below. He's lifted right up with the load so that he can handle the whole job by himself. The Hydro-Loader®, made by Stratton Equipment Co., Cleveland, lifts weights as great as 1,500 pounds up to seven feet off the ground. It folds against the truck when not in use.





Don't Throw That Shoe Away!

Workman tears off shoe's double sole to get at lining and insert a lengthening strip.

Shoes don't fit? This 70-year-old rebuilding process can make them longer or wider, even change style.

By C. Ennis

PS photos by W. W. Morris

BBETTER not throw away those tight shoes that pinch your feet every time you wear them. They might be worth fixing. This story tells how one shoe rebuilder solves the tight-shoe problem.

Using a 70-year-old method, the B. Nelson Co., of New York, can take a pair of ill-fitting shoes and make them one full size longer or wider than they were originally. The extra room is gained by ripping off the shoe sole and attaching a leather strip to the lining. Before this insert is added, a last of the proper style is fitted into the shoe so that it keeps its shape during the reconstruction process.

The Nelsonizing® technique can also be

used to restyle women's footwear. Toes and backs can be removed or put in, heel height changed, platform soles added or taken off, and the gaping sides of shoes corrected. If the leather on a shoe upper needs to be matched in the restyling process, skins in all types and colors are available. The strip of photographs at the bottom of pages 120 and 121 shows how style changes were made on four pairs of women's shoes.

Shoe-repair orders, covering a variety of requests, come from all over the world. Customers often ask to have slipper straps or other shoe parts replaced because pet dogs have chewed them. Sally Rand, the dancer, has the toes of all her shoes rebuilt because years of toe dancing have broadened her toes beyond the width of ordinary shoes. Turn the page and you'll see how the experts lengthen a pair of men's shoes. So don't discard those last year's shoes—to these shoemakers the "last" is just the beginning. ▶



1 Tape measure shows that size-11 shoe above, which is to be lengthened half a size to 11½, measures 12 inches from tip to tip before the rebuilding process begins.



2 A crosswise slit is cut in the canvas lining and insole of shoe above to attach insert. Note shoe's rearward shank, made of steel and cardboard, that supports the wearer's arch.



5 Operator evens shoe's edge on a trimming machine (above) before stitching on sole. A vertically moving feed bar jogs shoe past a knife-edged pick that chews off excess leather.

The shoe at right below shows how this pair looked before remodeling. To achieve the "D'Orsay" style (left), leather was cut away from the shoe vamp, making it lower.



6 Sole is sewed to shoe with waxed linen thread, softened by a heating unit in the machine. Well hole above the sole in photo is a bobbin case that holds thread.

The customer who owns these shoes wants to have the open-toe style. After the toe section is removed, a ribbon binding is sewed around the edge of the opening to give a neat finish.



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3 Having glued and tacked insert into slit of the shoe in foreground, worker cements a new cork sole cushion on shoe mate at right to give an even surface for attaching the sole.



4 After sandpapering the cork cushion (shoe in foreground) to give it a smooth finish, a leather sole is temporarily attached (shoe on the stand) with some rubber cement.



7 Before final polishing, sole is smoothed by holding it up to rotating rubber buffer. Smaller wheel is used to buff narrow part of sole. Funnel (upper right) draws off dust.

Black suede shoes with backs are remodeled to the backless style. When rear section is removed—as on shoe in foreground below—a strap and buckle matching rest of shoe are added.



8 After the rebuilding process is finished, worker measures the right-foot shoe to show how its length has been increased. Now it's about an eighth of an inch longer than before.

These shoes are getting a new pair of heels, the "French" heel at right being replaced by the "military" heel at left. Leather to match shoe upper is used on the new heel.



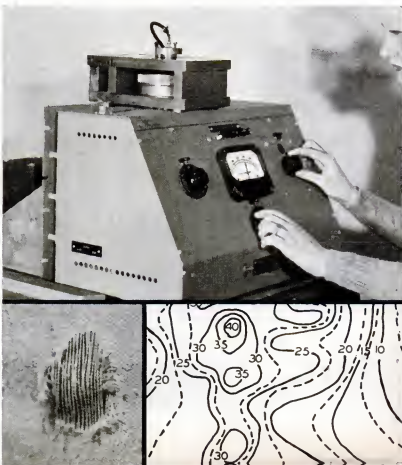
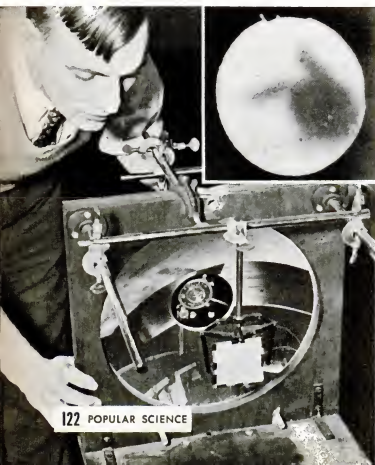


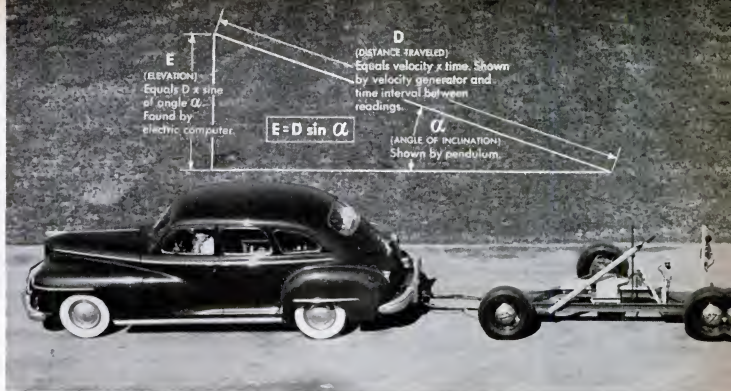
Clocking Meteors. Reclining comfortably in this shelter near Ottawa, Canada, stargazers for the Dominion Observatory time the flight of shooting stars. When one is seen, an observer presses a button that

registers the time on photo film. The same film clocks radar echoes when a meteor is about 60 miles above the earth. Echoes from Perseid meteors usually appear on a scope just as the meteors fade from sight.

Heat Makes Photos. Pictures made with heat rays, instead of light rays, now record objects' temperature patterns for Eastman Kodak technicians. Focused on a phosphor screen by a curved mirror, the heat rays produce a glowing image whose brightness varies with the object's temperature. This is photographed by a camera at a hole in the mirror (below). The inset shows a heat photo of a man's hand.

Map Reveals Wear. Placed in an instrument that measures electrical capacity of fibers, below, worn clothing yields odd patterns resembling contour maps. The capacity falls as wear increases, so that while only a hole may be visible (lower left), the map (lower right) reveals wear over the surrounding area. This permits more accurate measurements of a fabric's durability by National Bureau of Standards experts.



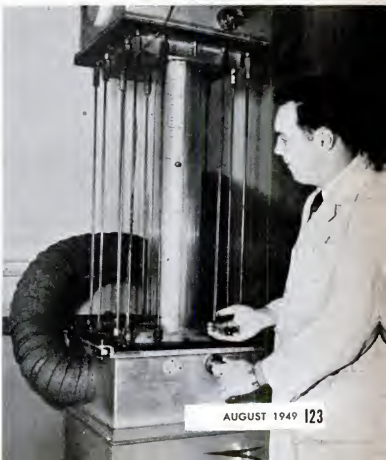


Up-and-Down Meter. Towed from one point to another, this Sun Oil trailer measures the difference in their heights above sea level, eliminating elaborate surveys. Distance is figured from a speedom-

eter, while a pendulum measures the angle up or down hill at which the car moves. An electric brain solves the illustrated problem in trigonometry thousands of times a second, totaling the results and final answer.

Flying Teakettle. Because water boils at lower temperatures with increasing height above the earth, the instrument below serves to measure altitude. Carried aloft by Army Signal Corps balloons, it brings water to a boil in a small vacuum bottle with the tiny doughnut-shaped electric heating element shown in the foreground. Called a hypsometer, it has another electric element that takes the water's temperature.

Bounce Tester. Dropping three-ounce ball bearings down glass tubes in the scientific "pinball machine" below, Firestone experts learn how new kinds of rubber will behave in extreme cold. At the bottom of the tubes, the ball bearings strike refrigerated samples of rubber. How high they bounce is noted against a scale. This is a test of the rubber's resiliency, which commonly decreases as temperature falls.



Jersey "Jungle"

Is Hottest and Wettest

Air conditioning in reverse creates man-made "rain forest" that outdoes Nature at her hot and humid worst.

By Herbert Johansen

PS photos by W. W. Morris

NOW the Army Signal Corps can enjoy all the discomforts of a steaming jungle right in northern New Jersey. The tropical chambers at Fort Monmouth provide everything from torrential rains to torrid humidity—and make them even worse than the originals.

Lock yourself inside one of these rooms and you'll get prickly heat, and fungus will sprout between your toes. The only things lacking are mosquitoes, palm trees, and pythons.

"And we could have those, too," says A. W. Rogers, of the supervising laboratory, "if they would serve any useful purpose. What we have is a fine piece of scientific machinery. A miniature jungle thicket might be exciting and colorful, but it wouldn't help us in our job of speeding up the effects of corrosion and tropical rot on the equipment we test—in getting answers in 10 days that would take 10 months to get in the field."

So the heavily insulated walls of the chambers, lined with corrosion-resistant Monel® metal, have a cold, clinical look. But there is nothing cold about these laboratories when a test is on to simulate a piece of equipment rotting deep in the New



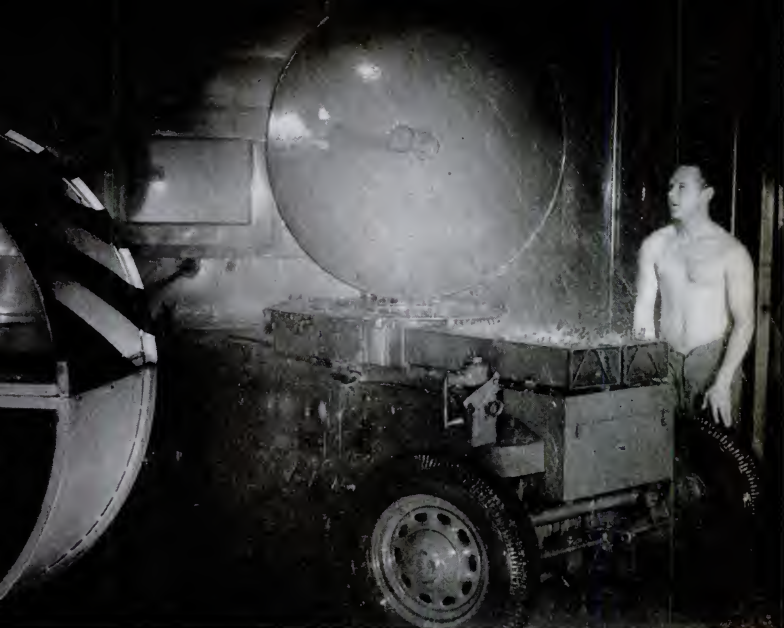
Mobile radar tracking set is rolled into the main tropical test chamber. Door behind the cone can be closed to make two test rooms. Note observation windows in the rear wall.



Inside, field radar set is ready for tropical test. Unit at left is electrically driven, stub airplane propeller that whips up a 40-m.p.h. wind. The room can hold a General Sherman tank.

Guinea jungle. With the controls set for maximum conditions, the heat climbs to an intolerable 190° F., with humidity at 100 percent, a soaking saturation. That's hotter and wetter than anything man is likely to find in jungle or desert.

"But," points out Thomas M. Child, head of the test section, "lots of our equipment got that kind of heat treatment during the war. Take a radio set inside a tank on the desert. You start with an air temperature of 125°. Desert absorption raises it to a ground temperature of 150°. Add another 10° and you get the thermometer reading inside the tank. And with the radio set itself generating heat, its parts might be operating at a sizzling 200° or more. In these chambers we not only duplicate that condition, but go it one better by adding humidity—and that's like boiling a radio set in water.



Here a tropical hurricane breaks loose in all its fury. Heat is on at about 180° F.; humidity is at saturation—with a torrential downpour thrown in. The technician at right can't take

it for more than 15 minutes, but the radar set must stand up under the grueling attack for many days to prove its mettle. Temperature-controlled rainfall comes from ceiling sprays.

If it comes through that treatment, we know it really will stand up."

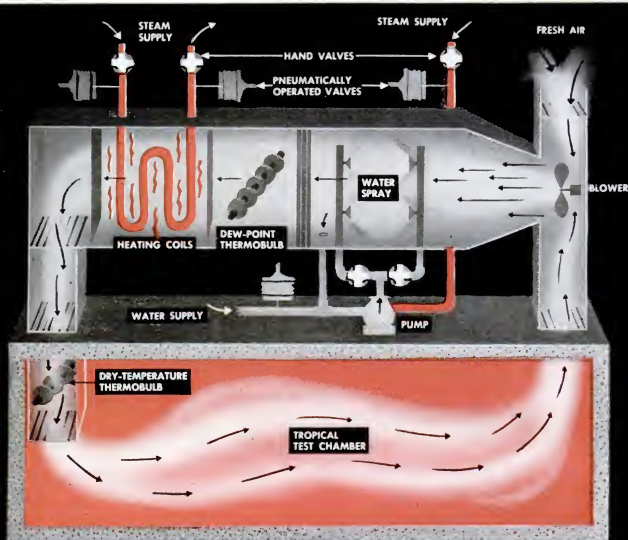
Mr. Child has been in one of the chambers with the temperature at 185° and the humidity high. Fifteen minutes is the most a man can take it, and he has to handle the equipment with asbestos gloves to prevent searing his hands. So real are these jungle conditions that working inside the chambers would be dangerous for technicians having any history of malaria or heart disease.

Another way of speeding things up is to accelerate the tropical cycle by setting the controls to operate twice a day from a low of 77° to a high of 150°, with high humidity. The effect of the increased condensation, producing greater absorption, is 10 times that experienced in an actual tropical day. Anything that comes through this corrosion test for 10 days and still works should be

good for at least a year of use under ordinary tropical conditions.

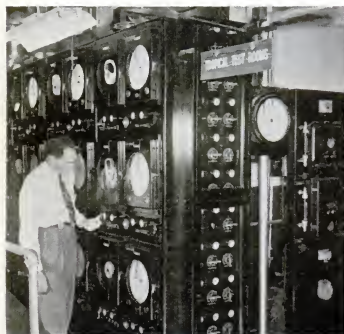
The tropical testing wing consists of six insulated rooms. The main chamber, more than 30 feet long and with a 14-foot ceiling, is big enough for a General Sherman tank or a mobile field radar set to be driven in and out. The machinery to produce the heat and humidity is located on top of the test rooms. Each room has its own unit, consisting of a circulating air blower, an air washer or humidifier, and radiator-like heating coils for temperature control.

When a room is in operation, there is an endless circulation of conditioned air. Coming up from the chamber, it is blown into the humidifier, consisting of two banks of water sprays. These sprays bring the air to the desired dew-point (humidity) temperature. The air then passes through an elimi- ➤

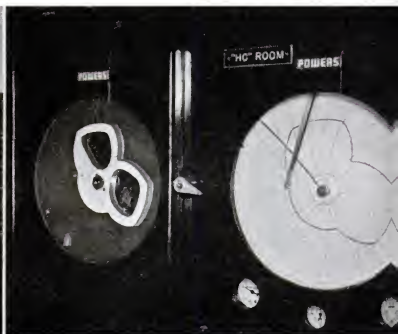


Schematic drawing above shows how heat and humidity are made to produce conditions worse

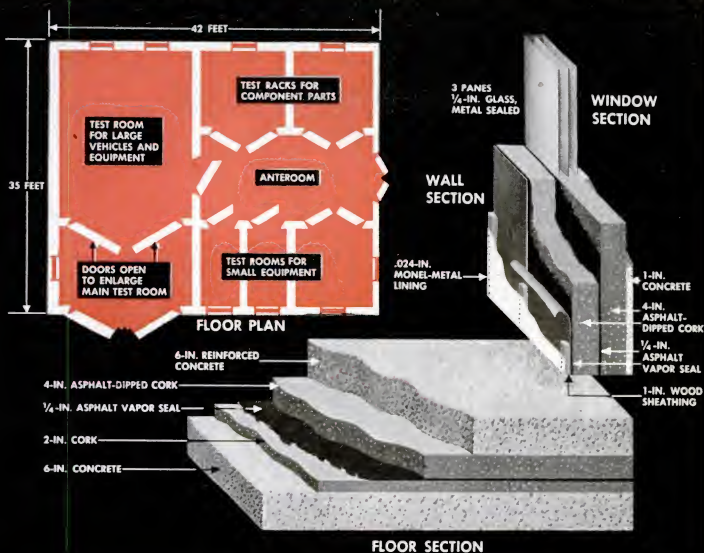
than those of any jungle. Each of the tropical rooms has its own climate-making machinery.



Each test room has its own controls on this panel located outside tropical wing. The system is pneumatically operated for smoother adjustment than that given by electrical controls.



Camis at left above are rotated by an electric clock, actuating control pointers that regulate heat and humidity. Circular graph at right records actual conditions in the test room.



The six tropical chambers are arranged in a U around an anteroom that also has heat and

humidity control. Sectional views above show how walls, floor, and windows are insulated.



This view shows part of the heat- and humidity-making machinery located on top of the test rooms. Technician is pointing to water-spray humidifier. It is air conditioning in reverse.



Small room above is used for testing component parts of communications equipment. Like all other rooms, it is lined with corrosion-resistant Monel® metal 25/1,000 inch thick.



Transformer above has been removed to check-up room for testing after two days of tropical treatment. This one is already ruined by corrosive action. It should have lasted 10 days.



Leather case at left was sprayed with a fungicide; the one at right was not. Both were given identical tropical treatment. Lessons learned from such tests are passed on to manufacturers.

nator screen that catches and retains any solid moisture (drops of water). From there the saturated air is blown across steam coils that raise it to the selected dry temperature, and then sent down into the test chamber.

Outside the wing is a panel with separate controls for each room that automatically determine the rate of change from one condition to another. The desired cycle is cut on two cams, one for dew-point and the other for dry temperature. Control pointers, or followers, ride the cams as they are rotated by an electric clock. If these pointers do not match the actual temperatures as registered by special thermometers, called thermobulbs, regulating valves are pneumatically adjusted on the humidifier and steam coils to bring about the control-set conditions. The cams illustrated in the picture at the bottom of page 126 have been cut to produce a minimum temperature of 77° and a maximum of 140° twice every 24 hours, with corresponding minimum humidity of 90% and a maximum of 98%.

Each room also has its own rain-making apparatus, a network of nozzle sprays suspended from the ceiling that will produce anything from a fine mist to a torrid downpour of two inches an hour. Added effect of a tropical hurricane is whipped up by the whirling of an electrically operated airplane propeller mounted on a mobile stand.

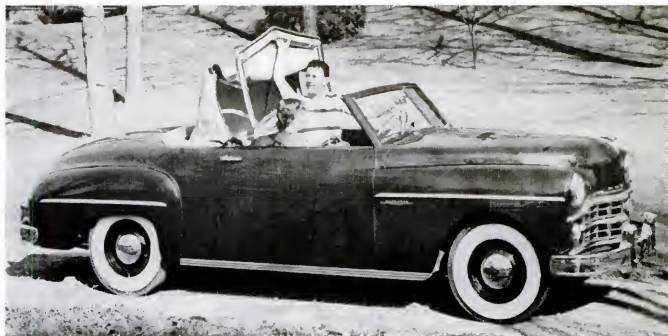
The Signal Corps has learned many lessons from its tropical roughhouse. Wherever possible, parts are enclosed and hermetically sealed. Molded plastics have replaced laminated plastics. The use of cotton and linen is avoided, and ceramic insulating surfaces are glazed for greater protection. An increasing number of parts are being

ordered from manufacturers with lacquer or varnish coatings. In the laboratory battle against fungus, ways have been found of effectively treating leather cases and insulating materials with fungicides that greatly prolong their life. Results of research along these lines, possibly of great value to industry, are made available to the public through the U. S. Department of Commerce.

But the jungle treatment is only half the story of climatic testing at Fort Monmouth. Across the hall are the companion arctic rooms (PS, March '48, p. 158) where man-made blizzards blow at 40° below zero. The Signal Corps is a firm believer that it pays to blow both hot and cold. **END**



Three Popular Science explorers, Herbert Johansen, W. W. Morris, and Robert Beals, cool off at 20° below zero in an arctic room after a safari through the Fort Monmouth jungle.



Dodge Revives the Roadster

REMEMBER that snappy little roadster of a decade ago with its single seat, buggy top, and buttoned curtains? Well, it's back—in modern style.

Roadster is the type designation Dodge gives its new Wayfarer® above. The 58-inch seat carries three persons comfortably. You can change from an open to a closed car in a matter of seconds. Just reach back, pull

the lightweight top forward, and slip one-piece plastic side windows, framed in aluminum, into sockets in the doors. While not in use, these are stored in a compartment behind the seat.

Built on a 115-inch wheelbase, the Wayfarer is powered by the standard Dodge L-head engine, but has a 3.73-1 axle gear ratio. It has Fluid Drive®, low-pressure tires, and bonded brakes. The factory price is \$1,635, plus taxes.



New Plymouth Hauls Big Load

PLYMOUTH's new all-metal Suburban® combines comfortable passenger accommodation and the cargo capacity of a small truck in one smart vehicle.

Its two seats take five persons. With both seats in use, an enclosed cargo space measuring 3½ feet long and a little over 4½ feet

wide remains at the rear. This carrying space can be lengthened to nearly 7½ feet by pivoting the rear seat into a floor well and opening the tailgate. Interior body height is 39¼ inches.

The Suburban is built on a 111-inch wheelbase and has the same 97-hp. engine found in conventional Plymouths. The retail price at the factory is \$1,740.

Physicist-M.D. Engineers New Radiation Tools

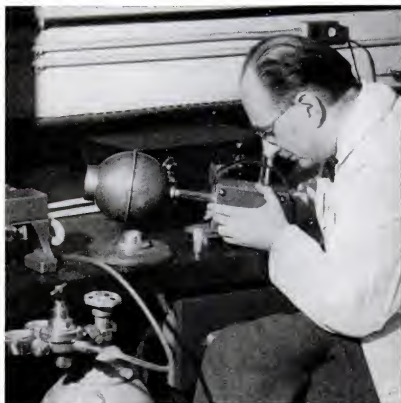


Shipment from Oak Ridge. Mt. Sinai Hospital receives Radioiodine 131 every week and Radiophosphorus 32 every fortnight. The iodine's half-life is only eight days, that of the phosphorus is 14 days. Iodine is used in treating thyroid cancer, phosphorus in treating leukemia, skin cancer, and other diseases. Dr. Sergei Feitelberg is seen here removing radioactive material with tongs from its lead container inside a sturdy shipping box.

A CANCER patient may someday be treated with a glass of water. This water will contain no more iodine than is in ordinary tap water. But this iodine, when it proceeds to his thyroid gland, may emit radiation that will attack cancerous tissue.

The patient will be the beneficiary of a new kind of workshop—one in which radioactive materials and instruments needed to use them are prepared for the doctors. Dr. Sergei Feitelberg now has such a workshop at Mt. Sinai Hospital in New York, and these pictures will give you an idea of his work.

Brig. Gen. David Sarnoff has suggested that a new word, "radionetics," be used to describe this kind of work. It involves the application of the physicists' knowledge to the problems of physicians. More and more such work is being done in hospitals throughout the country. The number of patients benefiting from it is increasing so rapidly that David Lilienthal of the Atomic Energy Commission believes "every human being in the United States may become a beneficiary of radiation."



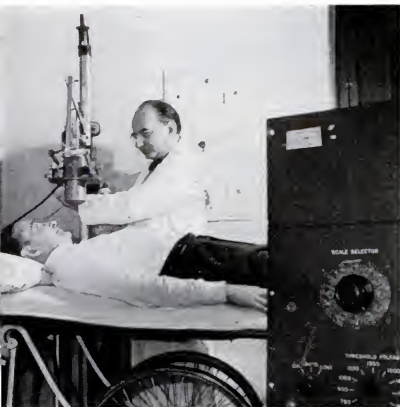
Ionization chamber that Dr. Feitelberg made himself is used to measure radioactivity of a few hundred-millionths of a gram of material. This part of his work might be likened to that of a pharmacist, but he often deals with quantities too small to be weighed. Lead blocks must be kept between him and some of the "prescriptions," and his supplies are kept in a locked closet. But accurate measurements make use of such materials perfectly safe.



At his lathe in his workshop, Dr. Feitelberg makes much of his own apparatus. He first studied engineering in Germany and England, then studied medicine in Austria, Germany, and Switzerland. During the war, he was in U. S. Signal Corps. Although he has not practiced medicine himself, he has found it helpful to have studied both engineering and medicine. His workshop in the hospital enables its doctors to make extensive use of atomic treatments.



X-ray diffraction patterns obtained with this instrument enable physicians to investigate molecular details of human tissues that are beyond the reach of their most powerful microscopes. This apparatus is used now to analyze kidney stones for data on which special diets can be prescribed for patients from whom the stones have been removed. It is also being used in the study of rheumatic skin nodules and in many other medical research programs.



Using a Geiger-Mueller counter, the doctor can trace his medicine after patient has taken it. Counter is mounted so that radioactive material can be located anywhere in body. This enables the doctor to tell exactly how much of the medicine that the patient has taken has reached those parts of the body in which it is needed. Scale selector at the right can be set so that nuclear disintegrations can be counted in groups of different sizes.



Impulses from the Geiger counter that detects radioactive tracers in the human body can be fed to a cathode-ray oscilloscope to aid record-keeping. This is another piece of apparatus constructed by Dr. Feitelberg and his collaborators in his hospital workshop. With such devices, he can solve problems that previously stumped doctors. Many instruments used in this work can now be purchased, but Dr. Feitelberg finds it helpful to be able to build his own.



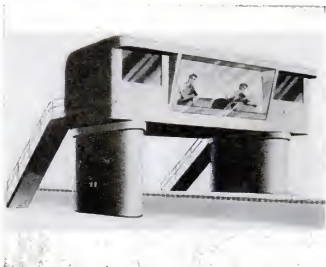
Cars Roll on Rubber Roads

FIRST state in the country to have a rubber road, Virginia has laid a 1,000-foot test strip on Route 250 outside Richmond. A small amount of powdered rubber, right, mixed with asphalt forms the resilient, long-wearing surface being applied above. Ohio, Texas, and Minnesota are also trying out the novel pavement. Originally developed in Holland, it requires from 600 pounds to a ton of rubber per mile. It is said to reduce car skidding, dust, and expensive and traffic-blocking road repairs.



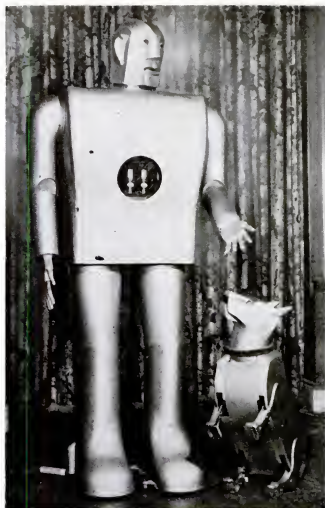
Tool Rids Crop of Pests

PLACED in a chamber of the hand-drawn British fumigator above, a nicotine smoke cartridge is ignited and vaporized to destroy insects attacking crops. A bellows geared to the axle varies the amount of generated smoke to suit the operator's pace, and a trailing canvas cover helps to hold the fumes in contact with the plants.

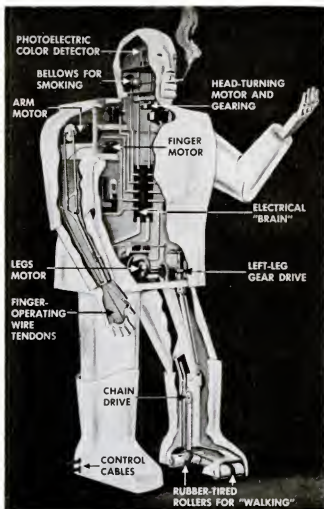


Steel Men Work in Comfort

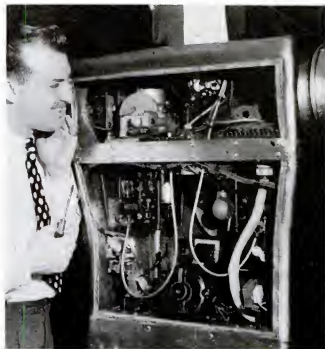
STEEL men who once worked in the open are now protected against heat, noise, and flying metal inside this modern steel-mill "pulpit" where operators control the rolling of red-hot billets. Designed by the Lee Wilson Construction Co., of Cleveland, it has air conditioning, an acoustical ceiling, and a heavy, shock-resistant glass shield.



Elektro walks, talks, and gestures, and his dog Sparko does tricks, at command of an attendant offstage. Four motor-driven rubber rollers under each foot enable Elektro to walk.



This hidden mechanism gives Elektro 26 life-like motions. He smokes cigarettes with motor-driven bellows, tells colors apart with electric "eyes" behind red and green filters.



Secret of Elektro's "brain," above, is response to number and spacing of words in command. What the words are doesn't matter provided phrase gives right number of electric impulses. Two-word commands start action; one word stops it; four words return relays to normal.

You Say It, Robot Does It

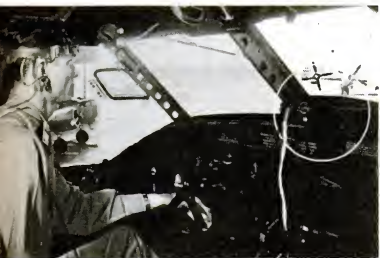
ELEKTRO may be dumb by human standards—but among mechanical men, he's a mental giant. He walks, smokes, counts to 10 on his fingers, speaks 77 words, and even distinguishes colors.

A star performer at the New York World's Fair 10 years ago, the seven-foot-tall, 260-pound aluminum robot has come back to the stage. Now he dramatizes the possibilities of Westinghouse controls for automatic machines at a Pittsburgh, Pa., industrial exposition. Elektro responds to an attendant's commands, spoken into a microphone or given by flashing a light.

Through 82 relays in his electrical "brain," these commands trigger 11 electric motors that work his mechanical "muscles" and turntables containing his vocabulary. An aluminum dog performs with him. **END**

What's New in Aviation

British Unveil Jet Bomber. Very secretive about their first jet bomber to fly, shown at right, the British say only that the plane was built by the English Electric Co., and that it is powered by two Rolls-Royce Avon® jet engines. It is of conventional design, with a straight wing. The bubble canopy cockpit is placed far forward for unobstructed vision. The engines, Britain's most powerful, are mounted in the wings.



Brain Waves Check Oxygen.

Lack of oxygen can knock a pilot out before he knows anything is wrong—with fatal results. But now the Air Force has a gadget that warns a pilot to adjust his oxygen supply. A modified electroencephalograph—brain-wave recorder—picks up electrical waves in the brain from electrodes on the pilot's head and triggers an alarm (circle) when the waves forecast a blackout.

Plane Sprays, 'Copter Dusts.

Piper's new PA-11 sprayer, left below, carries 47 gallons of liquid chemicals for killing weeds or bugs. The streamlined tank is under the fuselage and the 24 nozzles, fed

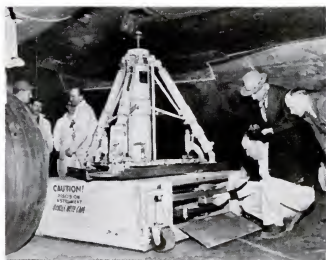


Big Bomber Gets Tractor Gear.

The Air Force's B-50 is trying out track-tread landing gear that will let it land on unimproved runways—or almost anywhere. The new "feet," with three times the "footprint" area of the usual landing gear, retract completely in flight; do not affect the 164,000-lb. bomber's 400-m.p.h. speed. Boeing designed, the main gear, above, was made by Goodyear; the nose unit, by Firestone.

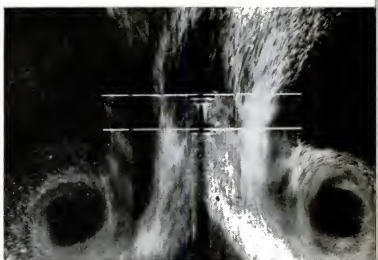
by a pump run by a wind-driven propeller, are under the wings, so they take no cabin space. The Kaman K-190 utility helicopter, at right, uses the down wash of its twin rotors to spread dust evenly over crops.





How to Weigh a Skyliner. If you are buying 80,000 pounds of Stratocruiser®, each extra pound means that much less payload. That is why Boeing guarantees the poundage of its double-deckers by weighing them before delivery. The Stratocruiser is so big it needs three 20-ton-capacity scales—one under each wing root and a third under the nose. Jacks on each scale then lift the plane off the ground.

Small Plane Copies 'Copter. The Heliplane®, below, looks like an ordinary plane. It can take off and land, however, in little more space than a helicopter. A tennis court can serve as an airfield and the little



'Copter Blades Churn Air. This pretty pattern shows how air flows past a pair of coaxial helicopter blades when they're increasing thrust quickly. It is an actual photograph, snapped against a black background, of balsa-wood dust being whipped around by the air stream of a laboratory model. The National Advisory Committee for Aeronautics made it as part of a study of the air flow of rotor systems.

plane can clear a five-story building 100 yards from its starting point. It can fly as slowly as 27 m.p.h. without stalling. Otto Koppén, of MIT, and Dr. Lynn Bollinger, of Harvard, designed the plane.

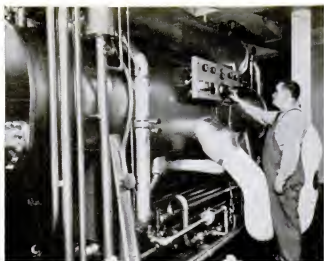


Steam Now Cools, Too

THE steam that warms buildings in the wintertime can now be used to cool them in the summer. In a new kind of air-conditioning plant, steam, instead of electricity, does most of the work. The steam may come from the building's heating plant, from a city central-steam system, or may even be waste steam from industrial processes.

The new system cools by evaporation—just as nature does—making use of the fact that heat is absorbed when a liquid turns to vapor. Heart of the machine is a chamber where water at room temperature is sprayed from nozzles, chilling itself by evaporation. The chilled water, piped as a refrigerant to individual room-cooling units, cools the air they circulate.

Up to this point, its principle is similar to that of other refrigerating systems. But it has no compressor to turn the vapor formed in the evaporation chamber back into liquid. Instead, the vapor is removed by a chemical solution—a solution of an inorganic salt—that has the property of absorbing water vapor. The steam is used to re-



Compact new air conditioner, powered by steam, supplies chilled water to room-cooling units through large insulated pipe beside operator.

concentrate the resulting diluted solution, for use again, by boiling off the water. This boiled-off water is then condensed and put back in circulation.

The new air-conditioning system was developed by the Carrier Corp. for use in office buildings, factories, and department stores. It has few moving parts—mainly pumps for circulating the liquid. Virtually noiseless and vibration-free, it may be installed on a building's roof or on any floor, as well as in the basement. A single unit is able to air-condition areas of from 34,500 to 60,000 square feet. END

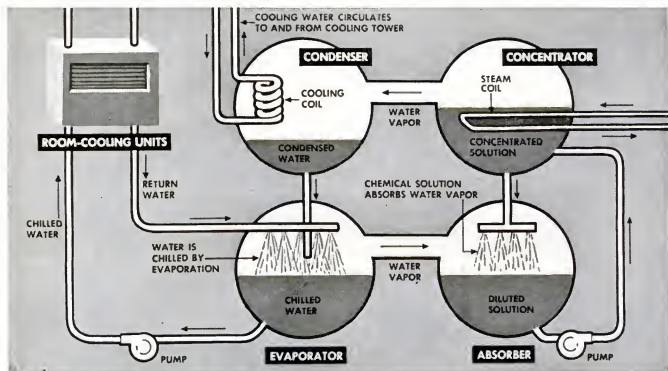
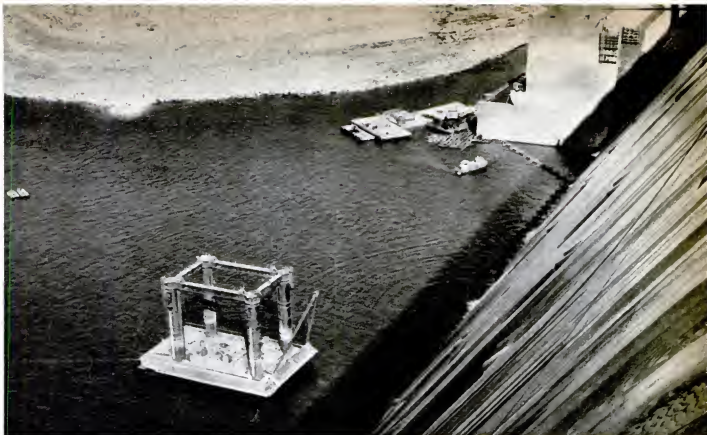


Diagram shows features of new air-conditioning system separately, for simplicity. In actual

machine, one chamber contains evaporator and absorber; another, concentrator and condenser.



The floating repair dock is shown above moored to Grand Coulee's spillway, seen at right. Still

undergoing tests, it won't start to work on underwater repairs until autumn, when flow slackens.

Barge to Fix Coulee's Toe

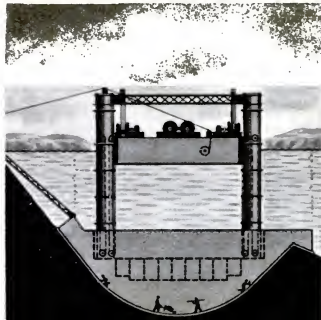
WHEN Washington State's giant Grand Coulee Dam was being built across the path of the Columbia river, powerful currents tossed boulders and gravel into the curved toe or "bucket" at the bottom of the spillway. They wore away the massive underwater masonry just as a grinding wheel wears away metal.

To get at eroded areas 70 feet under the swirling waters, Coulee Dam engineers have built a huge, 1,500-ton floating caisson that

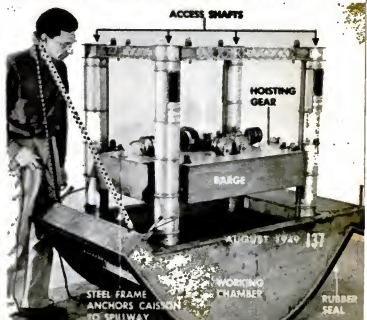
will give workmen direct and dry access to the concrete shelf. It consists of a barge from which is lowered a steel working chamber. The chamber fits snugly against the curved bucket, making a water-tight seal. Its open bottom covers 6,750 square feet.

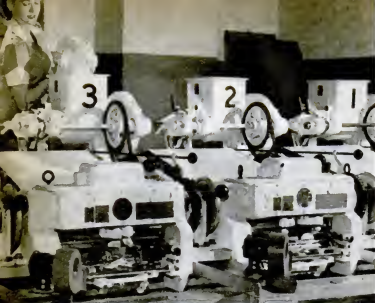
When the water has been removed by pumping machinery contained in two chimney-like shafts, workmen descend on an electric elevator through a third shaft. A fourth shaft is a hoistway for building supplies. **END**

Cutaway below shows the caisson's working chamber fitting tightly into the curved shelf of the dam's spillway "bucket," giving workmen free access to repair the eroded concrete surface.

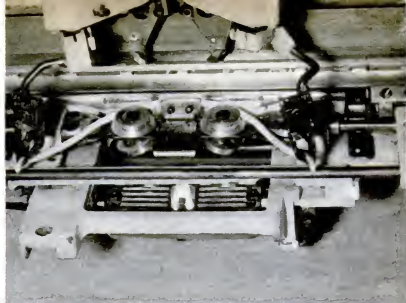


Exact in every detail, working model of the floating caisson, shown below, went through many trials in a water-filled test tank before Grand Coulee Dam engineers gave it their okay.





1 Fed into the hopper of the pretzel-making machine, dough is extruded through an opening at the hopper's side, and cut into proper lengths by a revolving knife blade.



2 Rolled into a "snake" by belts moving in opposite directions, dough drops to front of machine and is picked up by gripper fingers. They wrap it around a pair of shaping wheels.

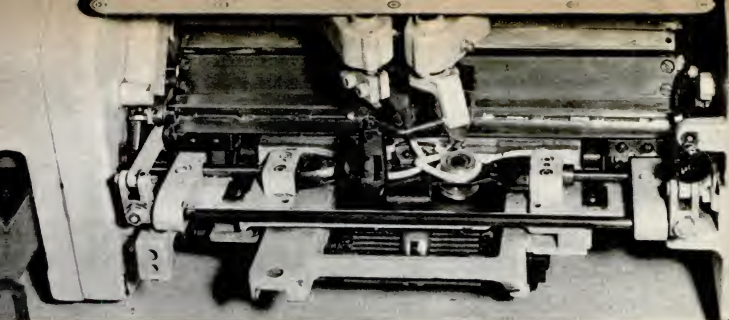
Machine Speeds Pretzel Bending



THERE are more crunchy pretzels to munch when you sip long, cold drinks this summer, thanks to a new automatic pretzel-twisting machine that rolls and ties them at the rate of 50 a minute—more than twice as fast as skilled hand twisters can make them. Developed by the American Machine & Foundry Co., of New York City, the pretzel bender is helping to meet the increased demand of pretzel lovers, who eat millions of pounds each year. On this and the following page is the story of how pretzels march from raw dough to baked twist.

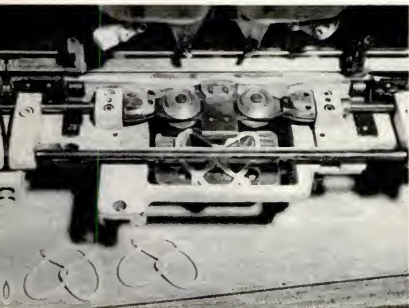
After the machine's mechanical hands have bent the pretzels into shape, they ride on a conveyer belt past a battery of infrared lamps that make the dough rise quickly. (Ordinarily, fresh dough has to set for a long period before rising.) Following the infrared-lamp treatment, pretzels are boiled in a salt solution at 225° F. to expand the dough and give it a toasty color. Then they pass underneath a hopper that lets fall a shower of rock salt. Finally the pretzels ride into a gas-fired oven, 90 feet long, for baking.

This bank of 15 machines, set up in a Baltimore bakery, twists 750 pretzels a minute. Diagonally mounted over a broad endless belt, each machine makes a row of the biscuits.

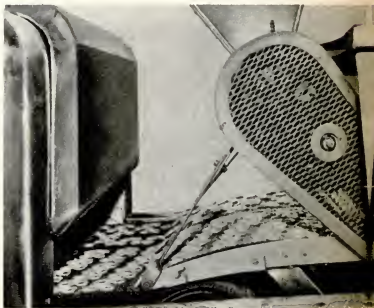


3 Imitating the tying motion of human hands, the gripper fingers cross over, looping the pretzel to give it the twist. Having completed its tying action, one gripper (above) swings

back to its original position while the other gripper finishes knotting the pretzel. The pretzel-forming wheels then pivot downward, dropping the tied pretzel onto a metal plate.

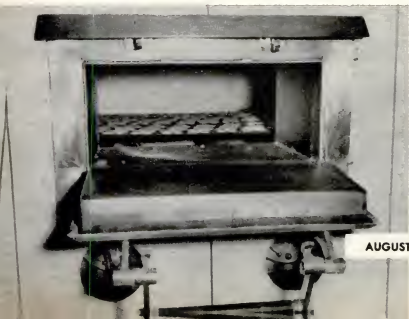


4 While fingers grasp another dough snake, plate holding knotted pretzel revolves, dropping it onto a conveyer belt that carries it through boiling and baking processes.



5 Traveling on a wire-mesh conveyer belt, the pretzels, which have been boiled in a saline bath, now receive a shower of rock salt from overhead hopper before moving into oven.

6 Through an observation door (below) in the lower part of a gas-fired oven 90 feet long, inspectors can check baking of the pretzels as conveyer belt moves through the oven.



7 Worker catches baked pretzels in a carton as they fall down a chute to a weighing mechanism that measures them in 12-oz. lots. Box is then closed and wrapped in cellophane.





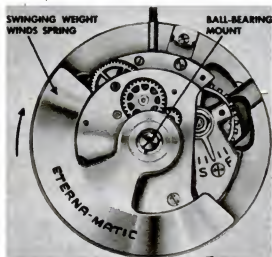
Fabric Reel Spreads Cloth

It's mighty hard to unroll a big bolt of cloth by hand. But this large machine does it at the touch of a finger. Gliding along an 84-foot-long pattern-cutting table, it spreads a heavy,

60-inch-wide roll of fabric in even layers. The bolt is threaded through rollers and aligned by guide bearings that roll against the table edge. The spreader was developed by United Air Lines' employees at the maintenance base in San Francisco.

Watch Is Always Fully Wound

THE merest motion of the wearer's wrist keeps a new, lady's wrist watch fully wound—thanks to the unique mechanism at the right. It is difficult to design a woman's self-winding watch, both because of its small size and because most women carry their handbags on the left—wrist-watch—arm, reducing the motion that keeps the mechanism going. Now Eterna claims to have solved the problem with a weight, attached to a matchhead-size mount having five tiny ball bearings, that swings in either a clockwise or counterclockwise circle to wind the mainspring. If taken off the wrist, the watch will run for 40 hours before needing rewinding.



Jacket Floats Victim Face Up

THIS British self-righting life jacket keeps you afloat face upward even if you're unconscious, lessening risk of drowning. You slip the collar over your head after strapping on the jacket. The hose seen at left on the jacket lets it be blown up by mouth should the inflating device—a small, gas-filled cylinder—fail to operate properly.



New Liquid Dulls Pants Shine

HERE'S one way to get that mirror look off the seat of your blue-serge pants. Killshine® is said to soften the fibers temporarily so that they can be brushed back to their original unflattened shape. This restores the nap and dulls the shine. Made by Vitatex Products Corp., of New York City, the nonflammable liquid comes with a special applicator.





An ultrasonic radar flight simulator in operation at Naval Air Station, Los Alamitos, Calif.

Copycat Radar Scans 20 Miles in 8 Inches

Sound waves bouncing in water tank give blind-bomber trainees realistic scope pictures from plastic maps.

By Andrew R. Boone

BY bouncing "silent" sound waves off a plastic map at the bottom of a small tank of water, U. S. bomber crews can spot on their radar scopes a target halfway around the world—without leaving their classroom.

What happens is this:

The sound waves in water act much like real radar pulses, except that they travel only 1/200,000 as fast. The result is a kind of slow-motion radar that is scaled down in both speed and range to operate within the confines of a classroom. By placing different map sections in the water tank, bomber

trainees can make simulated flights over any spot in the world.

Since the sound waves travel 1/200,000 as fast as radar, the relief maps are built on a scale of 1 to 200,000. Thus the maps are in the same ratio to real terrain as the sound waves are to real radar. Cities, seacoasts, and other landmarks are represented by Carborundum® crystals and glass beads, both excellent for reflecting sound waves.

Heart of the device is a quartz-crystal "airplane" from which the sound waves are radiated. Suspended in the water from a carriage sliding on tracks, the crystal can be moved anywhere around the tank to simulate the course of an airplane. Its "pilot," standing at a control panel, can direct its path and feed in all types of flight conditions by means of motor controls. Thus, the instructor can ▶

not only set up problems, but can also feed in their solutions as the mission progresses.

Operation of the device is simple: a pulse from regular radar equipment is directed at the quartz-crystal "airplane." The crystal vibrates at 15 megacycles for one microsecond, or millionth of a second. This creates ultrasonic waves (sound waves above the audible range) directed at the underwater map. The echoes that bounce back are received by the crystal vibrator, transformed again into electrical impulses, amplified, and fed into ordinary radar scopes. The scopes then show the students exactly the same radar pictures that would unfold before them if they were speeding along on a real mission.

In addition to the underwater map, a second, flat map, duplicating it, has been drawn on a sheet of glass that covers the top of the tank. Small lamps on the moving carriage below shine up through this map and show the precise position of the "airplane" at all times. And underneath the glass map is a large piece of paper on which a pen traces a continuous course of the flight.

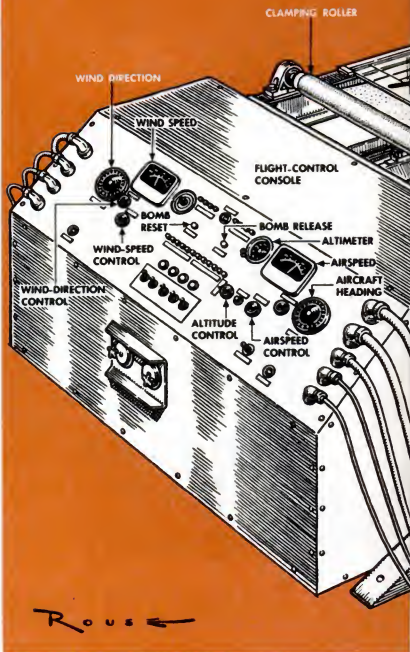
Tempest in Teapot

You can also play tricks with the Ultrasonic Trainer. A ragged-edged square of cotton dropped into the tank of water produces a realistic "storm front." A sprinkling of table salt creates the effect of radar "window jamming," achieved during the war by spreading aluminum foil from other aircraft. Airplanes in flight, singly or in formation, are simulated by dangling single Carborundum crystals by human hairs from tiny corks. A small metal strip, $\frac{1}{8}$ inch wide and one inch long, looks like a bridge when placed across a river; a longer strip would be taken for an air strip. Grains of sand, placed on the non-reflecting map areas that represent water, come out on the scope as ships or convoys.

The simulator aids training in many ways. It saves money by cutting instructional flying. It saves time. By hooking up a number of scopes to the amplifier, dozens of students can be trained at one time and kept proficient in the interpretation of radar pictures and the maintenance of constantly changing and improved radar equipment.

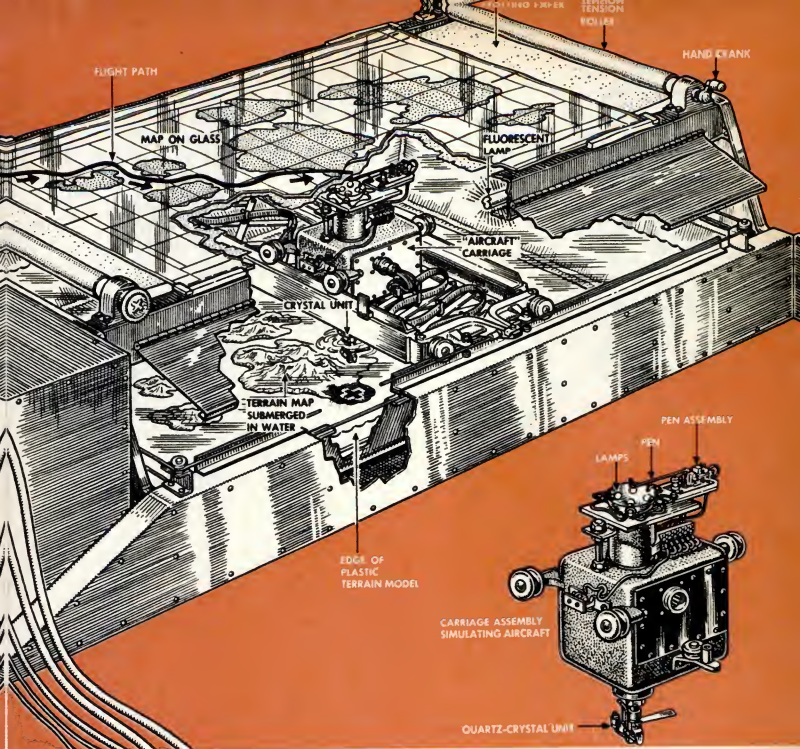
Lt. Ben G. Lewis, electronics officer at California's Los Alamitos Naval Air Station, where scores of reservists watch the radar "pips" move across the scopes, says: "When radar first reached us, we learned only by flying. Now we can sit in armchairs and watch the world go by."

END



Ultrasonic map is a plastic sheet built up with sand and varnish where "radar" reflections are desired. Below, blobs of Carborundum crystals are glued on to represent cities and other targets.

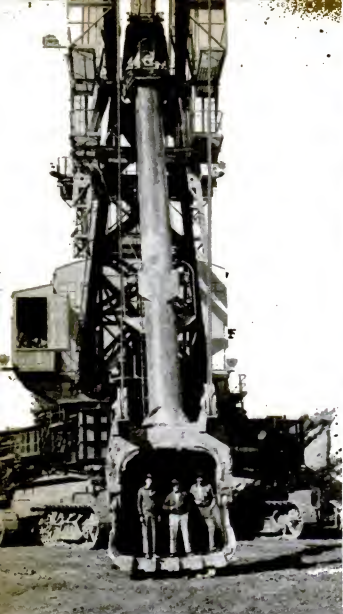




Naval officer below is making adjustment to the airplane simulator, or carriage, that moves in any direction over the tank. Suspended from it and submerged in water is the quartz crystal.

Peering into repeater scopes, students learn to interpret various radar patterns. They soon are able to identify the "pips" made by small crystals representing a large variety of targets.





"Dipper Stick" Made of Pipe

HUGE power shovels now have "dipper sticks"—the long arms—made of pipe instead of the usual braced girders. The cylindrical sticks are just as strong and much lighter.

The stick for this giant shovel, made of several cylinders welded together, was rolled by National Annealing Box Co. on a machine developed by Baldwin Locomotive Co.



Tester Twists Girders

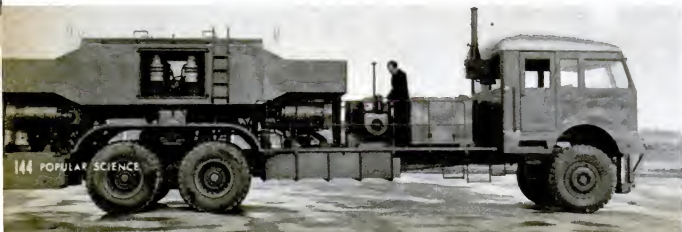
THIS machine twists heavy steel girders the way you wring out a wet bathing suit. The world's largest torsion tester, it is now being used at Lehigh University to learn more about the torsional, or twisting, strength of structural units. This is important in railway bridges, for example.

In Lehigh's giant twister, the test piece is clamped at one end to the stationary part of the machine. A drum, turned by an electric-powered press, twists it from the other end. Electric strain gauges measure the torque. The machine, which takes specimens as big as 16 feet long and four feet in diameter, can exert 2,000,000 pound-inches of twist.

Truck Tests Army Tanks' Pull

A 60-TON self-propelled dynamometer—biggest in the world—tells Army Ordnance engineers how powerful their trucks and

tanks are. It exerts a 60,000-lb. pull at speeds up to 45 m.p.h. Test vehicles pull against the dynamometer, whose 19 electric generators create accurate resistances. Cameras in the huge cab record test data.



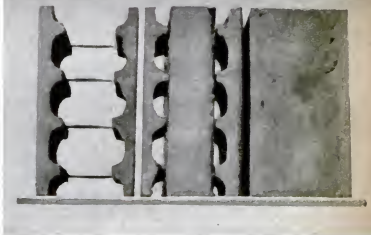
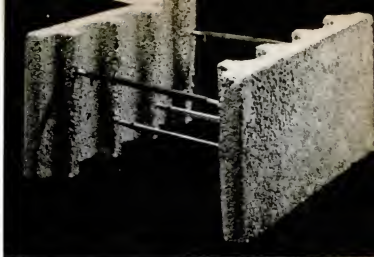
New Blocks Make Walls Fast

CEMENT blocks have been crossed with pouring forms to produce a new building material. Called Klee-blocks®, the units consist of two 8- by 16-inch pieces of concrete held rigidly apart by steel connecting rods (right, above). The rods are adjustable so that the thickness can be varied.

The Klee-blocks essentially make a permanent form for various types of concrete walls. The blocks are laid without mortar, and the hollow centers can then be filled solid with poured concrete, creating a strong, steel-reinforced wall of the monolithic type.

Another Klee-block wall has a sandwich core—two layers of insulating cardboard with poured concrete between. This core leaves the corrugations in the inner faces of the block empty, for use as raceways for wires and pipes or as ducts for hot or cold air. Lower photo at right shows these two types of "filling" and an unfilled block.

Klee-blocks, which can be shipped unassembled or assembled, are made by the Klee-block Corp., Belfast, Me.



Machine Scrubs Sidewalks

SHOPPERS will walk across extra-clean sidewalks to enter the snooty shops on New York's upper Fifth Avenue. The walks are to be scrubbed by an adaptation of the standard street-cleaning machine. It sprays chemicals and water on the walk, then two brushes scour the pavement. One is a five-foot cylinder brush; the other (visible at left) is a circular brush that gets into the angle between building wall and street.



Train Travelers Can See Speed

TRAVELERS between Washington and Chicago will be able to keep tab on the engineer if they ride the Baltimore & Ohio's New Columbian trains. The Strata-Dome® car, which gives passengers a bird's-eye view of the scenery, also has an instrument panel with a speedometer. The other dials (center in above photo) are a clock, an altimeter (so you can tell how high you are when you cross the Alleghenies), and a barometer.

Ice Grows Out of Fast Freezer

By Walter F. Oakes

A NEW ice-making machine freezes ice so fast you can see it grow.

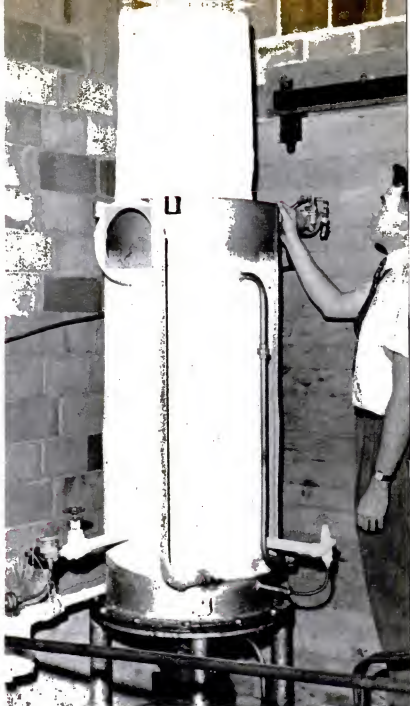
Invented by Prof. John R. Watt, of the University of Texas, it can squirt out a ton of ice a day—like toothpaste from a tube—50 percent cheaper than standard equipment makes ice.

The secret of its speed lies in freezing the water from the inside out, where old methods freeze it from the outside in. Just as nature forms hailstones, the Watt machine wraps successive thin layers of ice around a core, building big blocks at 30 times the usual rate.

Today most ice is made by suspending large cans, each containing 300 pounds of water, in pools of very cold salt water. It takes 40 hours for a can to freeze solid because the ice first forms around the edge, creating an insulating layer that slows freezing of the inner water. This low production rate, plus the labor involved in emptying the cans, adds to the cost of ice.

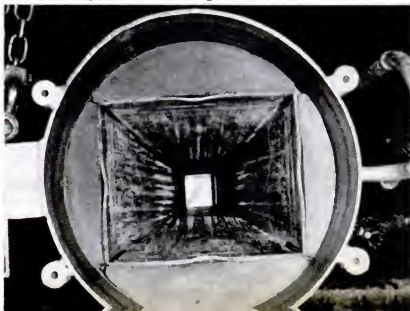
Prof. Watt's machine both speeds the process and eliminates most of the handling. To start, pre-chilled water fills a freezing cylinder shaped like an upside-down pyramid. Refrigerant in the cylinder's hollow walls freezes this water solid. Then a ram in the bottom of the cylinder lifts the ice block a quarter-inch, shearing it away from the sides of the cylinder. Because of the tapered shape, this lifting creates a thin space between the raised block of ice and the steel walls. Water flows into the space and quickly freezes to the ice block, forming a new layer—called the "incremental film"—on the lower sides and bottom. Then the ram lifts the ice block again, and the process is repeated. Automatic blades slice off blocks as they rise out of the cylinder.

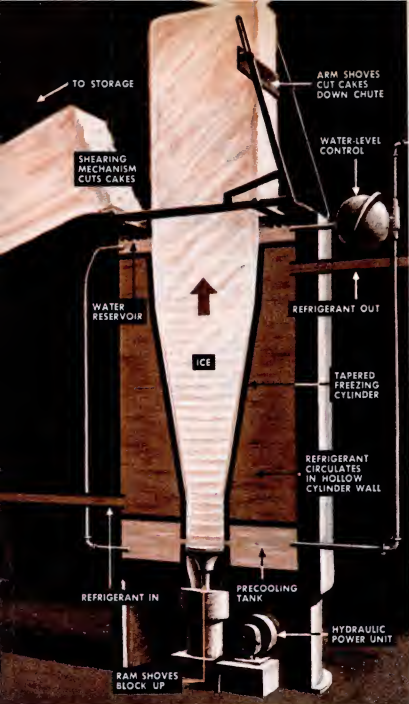
Other continuous ice-making machines have been built, but they turn out flakes, cubes, and other small forms that are not as suitable for refrigerating railroad food cars and other of the most common ice uses as the big blocks frozen by this machine.



Ice grows right out of the top of this new machine. This model, the first one of commercial size, can make 80 lb. an hour. A device to chop off blocks of the right size can be added.

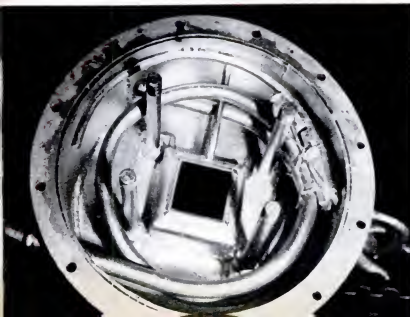
Looking down on freezing cylinder, you can see its pyramid-like form (below). Ram operates through small square hole at bottom. Space around the cylinder holds the pre-chilled water.





Fast, continuous operation depends on tapered shape of freezing cylinder. Ram at bottom lifts block, leaving space around it that fills with water from reservoir. Water freezes new layer on block.

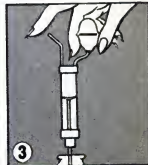
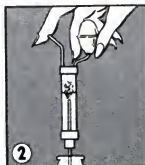
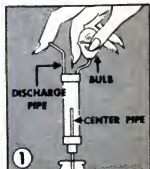
Water enters machine at the bottom through the small curved pipe. It is chilled by passing over refrigerating coils before flowing into the reservoir that feeds it to the freezing cylinder.



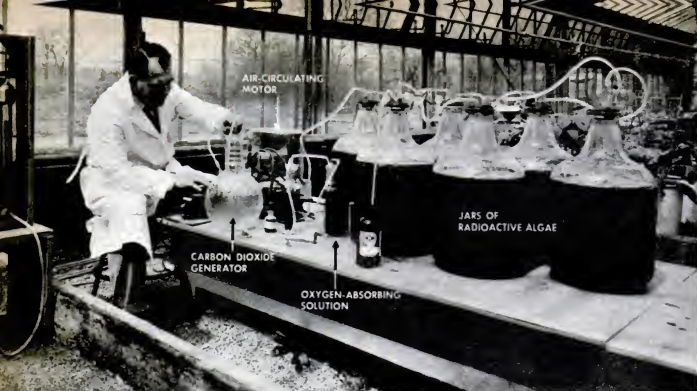
Measures Out Just One Dram

THIS automatic pipette transfers exactly one dram of perfume—to the drop—from a large bottle to a small one. Designed for use at a sales counter, its ingenious principle might also be used in laboratory measuring devices. Squeeze and release its bulb, while holding a finger over a discharge pipe, and its chamber fills with liquid from a bulk container. Take your finger off the pipe, and excess liquid drains back until the level falls below the top of the central drain pipe—leaving a precisely measured quantity to be poured out. It is made by Schindler Stamping and Toy Co., of Cleveland, O.

Place center tube in liquid, cover discharge tube with finger, and measuring chamber will fill when bulb is pressed (1) and released (2). Lifting finger (3) breaks suction and excess liquid drains back into container.



Exactly one dram of liquid remains in measure, which is inverted (4) to pour it out. Here, the measure is shown in use for transferring perfume from flask to small bottle.



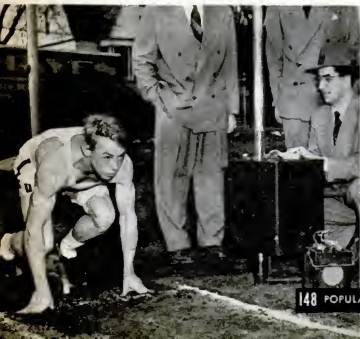
Algae Work for Science

ONE of the simplest forms of plant life, made radioactive, will give scientists a new tool for probing the secrets of life processes. Algae are being "tagged," then fed to research animals. It is hoped that they will reveal details of animal metabolism. In the

photo above a researcher at the "isotope farm" of the Argonne National Laboratory in Chicago is preparing a mixture that creates radioactive carbon dioxide. Pumped into a culture medium of algae, this makes them radioactive. A limited quantity of these algae is being made ready for use by qualified scientists and research institutions.

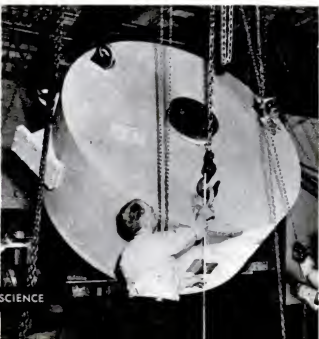
Photo Eye Starts Runners

TRACK-MEET events are guaranteed a fair start by the photoelectric-cell device shown below. It not only automatically fires the starting pistol, but blows a foul horn on any contestant who tries to beat the gun. The photo-eye light barrier is beamed along the starting line in front of the runners to a reflector placed on the opposite side of the track. Also used successfully in swimming meets, the portable, battery-operated unit is made by the Electric Eye Equipment Co., of Danville, Ill.



A Big Tankful of Volts

FUTURE billion-volt X-ray machines may be foreshadowed by a new type of General Electric synchrotron of 300,000,000 electron volts. Called a "nonferromagnetic synchrotron," it dispenses with the usual massive electromagnet of many tons' weight. Instead, it employs the magnetic field of comparatively lightweight, solenoid-type, current-carrying coils within the compact cylindrical vacuum tank below. The same tank serves as an accelerating chamber for electrons, eliminating a separate "doughnut" tube.



Firemen Take Train to Fires

THESE firemen go to a fire on a railroad train—one that's painted bright red, naturally. They are part of the fire-fighting force of the British Railways, which includes 7,700 men in one region alone.

Recently re-equipped with the latest types of fire-fighting apparatus, the red trains can be on their way at a 60-m.p.h. clip within five minutes after an alarm. Each carries 8,500 gallons of water, miles of hose, foam units for oil fires, and mobile pumps that can deliver 350 gallons a minute.



Bright red fire trains of the British Railways are kept ready to fight fires on railroad property. Car behind engine carries the 8,500-gallon water supply; others hold crew and equipment.



Special equipment car has hose, ladders, foam units, floodlights, hand pumps, and 350-gallon-per-minute motor pump. Note big doors behind mobile pump that open up entire end of car.



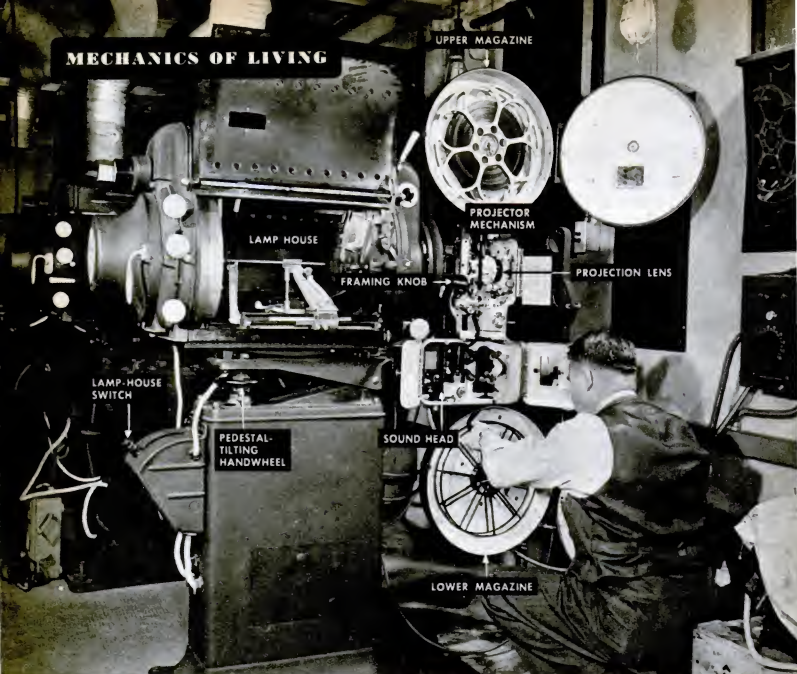
A ramp lets the powerful mobile pump down from the equipment car. Men at left lower it slowly with the help of a block and tackle, while others behind the pump guide it into place.

Helmeted fire fighters of the railroad stage a demonstration in the yards. This protection force,

numbering many thousand men, is kept on standby duty for quick response to emergency calls.



MECHANICS OF LIVING



A theater movie projector, like this 775-lb. Simplex®, produces its pictures-and-sound show with a light source, an intermittent mechanism that throws a fast succession of still pictures on the screen, and a system for converting light

variations into sound. Here an operator is finishing the threading procedure, taking the film leader as it comes down from the sound head and attaching it to the take-up reel. Note the ducts that lead heated air from the lamp house.

How Motion Pictures

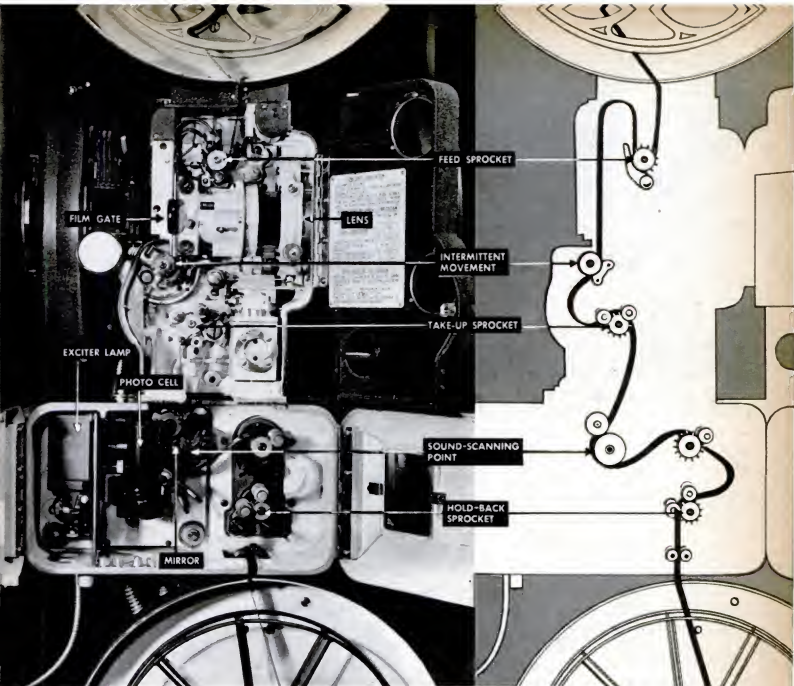
By Devon Francis

PS photos by Hubert Luckett

THE next time you go to a movie, begin watching the upper right-hand corner of the screen about 19 minutes after the feature goes on. If your eye is sharp, you will presently see a dot—white if the background is dark, or black if the background is light. It will last for only about 1/6 of a second, and eight seconds later another dot will flash by.

These dots are cues used by that past master in the art of legerdemain, the projectionist.

The first dot warns that it is almost time to switch reels. The second one signals the instant to do it. As it appears, the operator neatly chops off the image being thrown on the screen by one machine, together with its sound, and cuts in the image and sound from a second machine. He does it so deftly that the audience, preoccupied with heroine or hero, is unaware of the transition.



Film path through the "mechanism"—trade lingo for the intermittent film-transport device—and the sound head is shown here. Each frame of film is projected for about 1/45 second; illusion of movement comes from eye's persistence of vision.

In sound head, light beamed through sound track on film strikes photoelectric cell, giving fluctuating currents that are amplified and fed to speakers. Sound track may be either bands of varying transparency or a jagged opaque pattern.

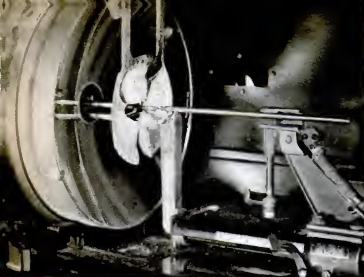
Are Projected

The projectionist is a magician. His main prop is an elaborate, costly machine designed to kid our senses with an illusion of reality. To throw the shadows from a film strip on a screen, and to make an eye "see" them move, costs even a small, two-machine theater, with sound equipment, about \$8,000.

Modern theater projectors have come a long way since the invention of the zoetrope in 1853. They have come a long way, in fact, since the kinetoscope and cinematograph be-

fore the turn of the century (PS, Dec. 1897, pp. 177-188).

A projector consists of three essentials—a lamp house, a film-and-shutter mechanism, and a sound head. The first provides the intensely bright light required. The second shoots 24 separate still pictures a second onto the screen. And the third converts the squiggle of the sound track into minute electric currents that, greatly amplified, produce the sound. ▶



Inside lamp house are two carbons in front of highly polished reflector. A shield protects reflector from splatter when 65-amp. arc is struck. Motor keeps carbons properly spaced as they burn back; pair lasts for about three reels. This two-kw. arc gets really hot—about 5,500° F.



Two shutters clip the light while new frame of film moves into place. Although both shutters actually turn in the same direction, the rear one is behind the lens so its motion on the screen is reversed. Together they "scissor" off the light. Rear shutter also helps protect film from heat.

A projector is a complex, semi-automatic robot. The switch in reels and machines, for instance, occurs when the operator steps on a foot switch and triggers the "change-over." Solenoids in the machine being shut down operate a "douser" that cuts off the light and switches off the sound head, while other devices cut in the second machine at the same precise instant. The entire change-over may take less than 1/20 of a second.

Even the notification that the reel is nearing its end and that the synchronizing dots are due on the screen is automatic. When the upper (supply) reel is full it turns at 22 r.p.m. When it's almost empty it turns at about 85 r.p.m. The effective diameter of the film whirling on the reel has shrunk; the mechanism still takes the same amount of film per second, but it now takes many more turns to supply it. When the reel builds up to about 75 r.p.m. a bell or buzzer, set off by a centrifugal speed trip, tells the projectionist to stand by for the change-over.

He is prepared. He has threaded the second machine. He strikes and adjusts the arc in the second lamp house. In a moment he switches on the current to start the second machine rolling and bring it up to speed. Practice tells him when his 20 feet of "leader"—the part of the film the audience never sees—will have run past the film gate and through the sound head. The leader has three parts—a protective leader that can dangle on the floor and get dirty in the threading process, an identification leader that shows if the reel is in sequence; and a synchronizing leader that overlaps the action of the reel running

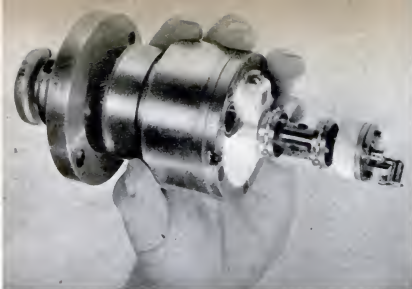
out. When the second dot appears he trips the change-over switch and the job is done.

Projectors use both AC and DC. A constant-speed AC motor drives the film-transporting mechanism and the take-up reel, and AC is also the power supply for the sound system. The DC supply, usually provided from a rectifier or motor-generator set, is used for the lamp-house arc. An ingenious variable-speed motor feeds the positive carbon into the arc at just the rate that the carbon is burned, maintaining a constant level of illumination. Variations in the amount of current in the arc, which depends on the distance between carbons, cause this motor to change speed.

Projectors Still Require Supervision

The projectionist isn't idle between reel changes. Like everything mechanical, projectors require supervision. Despite its automatic feed, the arc may need occasional attention. Or the sound level in the theater may grow too high or low. This may be due to an increase in the size of the audience; an almost empty house needs less sound than a full one, because human bodies and clothing absorb sound waves. Or the audience may be one that knocks itself out laughing at a comedian, drowning out the sound from the big speakers by the screen. In most theaters the projectionist has a sound-monitoring speaker in his booth, but often the actual level is fixed by ear from the auditorium, the operator being phoned to lower it or boost it.

Another of his jobs is to check the focus of the picture. Even though the lens-to-screen distance is constant, minute variations in



Intermittent movement, which is removable as a unit, is the heart of a projector's film-transporting mechanism. Its job is to pull a frame of film down, halt it briefly, and then pull down another—and do this 24 times a second. A $\frac{1}{4}$ -hp. AC motor powers this mechanism and the take-up reel.

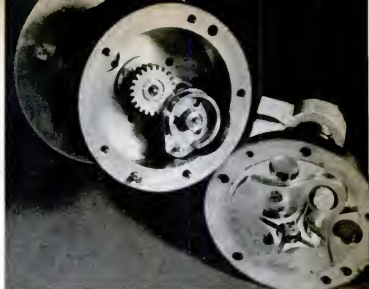
thickness of the film stock may destroy sharpness of the image. He takes care of that with a micrometer focusing screw.

Improvements in both projectors and projecting techniques have largely eliminated the film breaks or misframings that, in days gone by, caused audiences to stamp their feet or clap in impatience. With a well-maintained projector, these troubles are almost always attributable to faulty splices, and today no operator worth his salt will let a defective splice leave his hands.

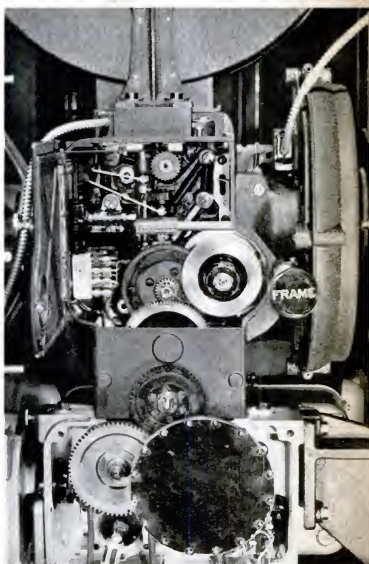
Film fires are also almost unknown these days. The film races past its scorching hot light source at 90 feet a minute. An automatic fire shutter, also triggered by a centrifugal governor, drops down between light and film if for any reason the speed falls to 50 or 60 feet a minute. Even if the film should catch fire, it can burn only in the projection mechanism and sound head. Fire rollers at the exit from the top magazine and the entrance to the lower one keep any fire from spreading. As an added precaution, there are magazine doors that deny the spooled film an adequate oxygen supply.

The fact that shows in big theaters or little neighborhood houses alike are almost always run off these days without breaking the illusion of reality is a testimonial to both the machines and their operators. Only in the case of major breakdowns or current failure does a show have to close down, and these contingencies are rare. The magic machine that creates mass illusion for millions of Americans each week does its intricate job with high precision.

END



Taken apart, the intermittent movement looks like this. A gear-driven eccentric pin in the left-hand section flips over the slotted star or Geneva wheel in the right-hand part. The pin turns constantly; the Geneva wheel turns only as the pin engages it, moving the film ahead one frame.



A complex gear train is used in modern projectors, as this view of left side of the mechanism shows. Many parts run bathed in oil, and elaborate seals are needed to keep oil from film passages. An oil-damped flywheel aids the constant-speed motor in maintaining correct sound pitch.

Plant Chops Old Bottles for New

SMASHING old bottles can be a bigger job than you'd think. Breaking and washing half a million every day requires a \$250,000 plant especially designed for this important industrial process.

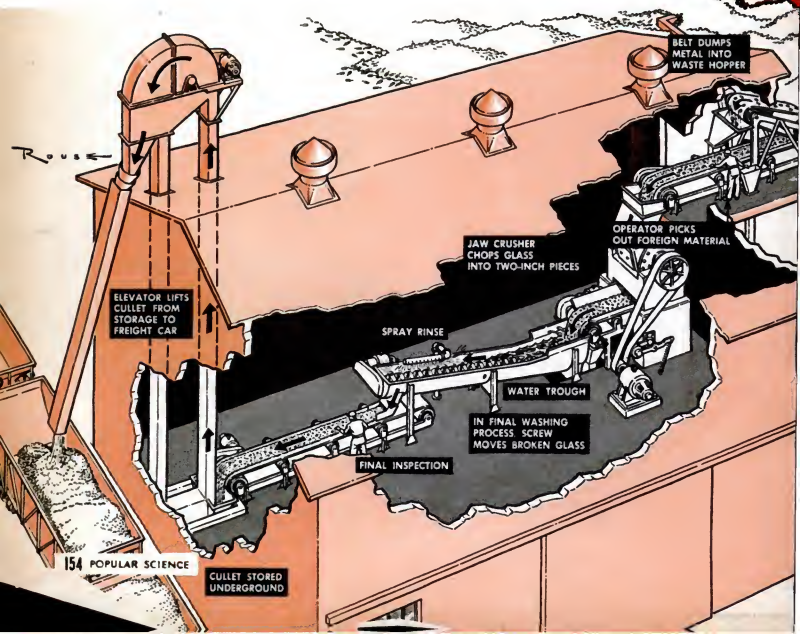
A South Gate, Calif., scrap-glass dealer, M. I. Sessler, has built a new, almost completely automatic plant that does just that. At one end it takes in used glass; at the other end it pours into railroad cars smooth, clean, reclaimed glass, called cullet. (The name comes from "collar," the piece remaining on an old-time glass blower's pipe after he had finished blowing a bottle.) Cullet is added to the batches of raw materials in making glass—



From mountain of discarded glass, bulldozer starts material on its way to becoming cullet by shoving it into pair of 500-ton-capacity concrete hoppers that feed the crushing plant.

a new bottle may contain up to 40 percent.

In the Sessler plant, old glass passes through a series of washers, a crusher, and under an electromagnet (to pick out stray metal), as shown in the drawing and photos. Human hands touch the broken glass only to pick out the last bits of foreign material.

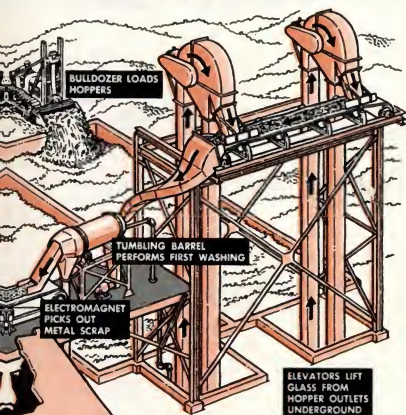




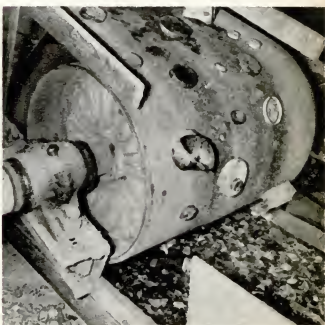
Under the hoppers, electric vibrators shake the glass out of these openings onto 30-in. conveyer belts. Each of these vibrators can shake about three tons of glass out of its hopper every hour.



The belts carry their loads to elevators 60 feet high (above) that lift the glass onto a second conveyer. Conveyer feeds glass to the first washer, a tumbling drum (center right of photo).



The glass next falls into this crusher, whose jaws snap raw material into two-inch pieces. A second magnet then picks out metal knocked loose in crusher.



After washing, the scrap material passes under an electromagnet that pulls out bottle caps, cans, and other metal and makes them stick to the belt. The belt then delivers them to a waste hopper.

This is cullet after final, two-step washing, and inspection, ready for shipment to bottle maker. The cleaning process rubs off sharp edges so that it can be handled without danger of cuts.





Construction of the world's largest pumps starts with this wooden core box. Made of Honduran mahogany, it forms the sand core of the mold in which the impeller wheel of the pump is cast.



The cores are carried by an overhead conveyer into an oven to be baked hard. This core is one of seven that will create the seven water passages in the 14-foot-diameter impeller wheel.

Biggest Pumps to Lift River into Wasteland

By Andrew R. Boone

THE biggest pumps in the world will soon be turning the clock back to the ice ages, making water from the Columbia River flow in a channel unused for at least 300,000 years. They will lift water from Lake Roosevelt—formed by Grand Coulee Dam (PS, Feb. '36, p. 11)—about 270 feet over a hill to an irrigation reservoir. This water will turn more than 1,000,000 acres of near-desert into some of the world's best farm land.

The last time Columbia River water flowed through this area—a plateau called the Big Bend, around which the river now circles—was in the Pleistocene epoch, when huge glaciers covered most of North America. One glacier grew across the river, right where the man-made dam is now. The water piled up behind this ice block until it finally overflowed the surrounding hills and cut a new channel. The Columbia ran there a long time, wearing the hill passage down to a sharp gorge a sixth of a mile deep called the Grand Coulee. But eventually the glacier melted, the Columbia went back to the channel it had used before—and uses today—

and the Grand Coulee was left high and dry.

When the giant pumps are running, water will again fill the Coulee. It will serve as the reservoir, feeding canals that are to carry the irrigation water to the farms. Experts of the U. S. Bureau of Reclamation, which planned the project, estimate that the new farm land created in this way will be equivalent to adding a whole new state to the Union.

Almost everything about the Grand Coulee undertaking is the world's biggest. The pumps are at least eight times larger than any similar ones. Each can handle more than enough water to supply all New York City. Grand Coulee Dam is the biggest ever built, and the biggest masonry structure of any kind ever built—more than five times the size of a huge Egyptian pyramid. It will produce more electric power than any other.

The first of Grand Coulee's 12 pumps is expected to be installed next year. Made by the Byron Jackson Co. and the Pelton Water Wheel Co., each pump will have a 14-foot impeller wheel driven by an individual, 65,000-hp. electric motor. Power will come from the dam's own generators—making the Columbia lift itself by its bootstraps.



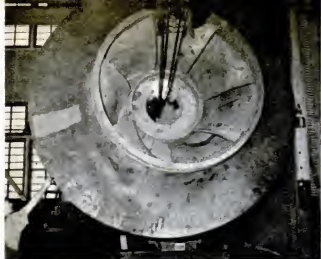
Inside a nine-foot-deep pit, workmen guide third of the seven core sections into place in the

mold. Steel from two 25-ton open-hearth furnaces at Columbia Steel Co. filled the mold.

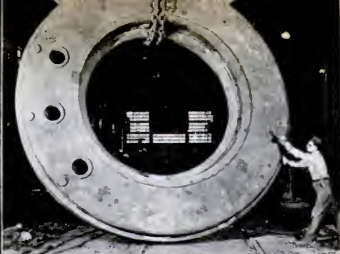
The impeller wheel looks like this when the mold is first broken away. Stumplike projections

are "risers"—extra steel left in filling holes of mold. All excess like this is later machined away.

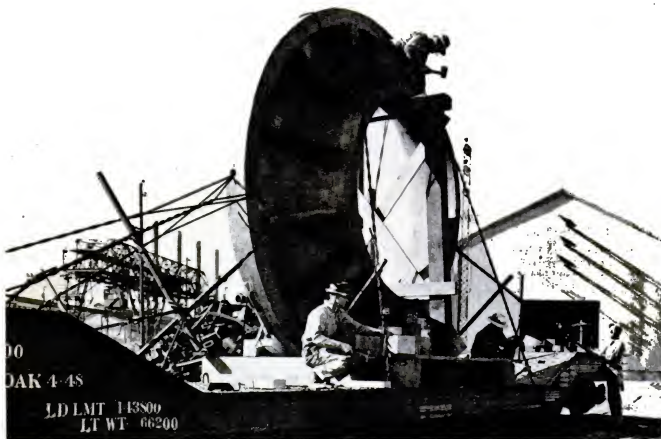




After machining has cleaned off 20 tons, impeller still weighs nearly 30 tons. It is one of 12 that will divert part of Columbia River over 270-ft. hill into ice-age channel in Grand Coulee.

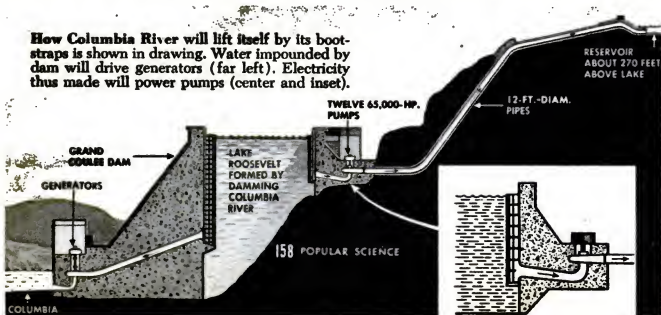


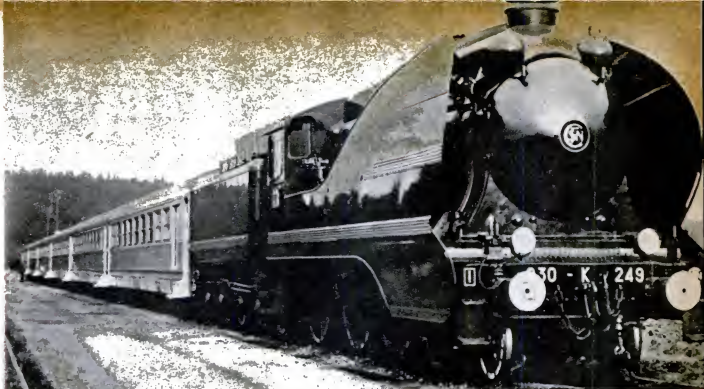
Head cover, weighing 38,000 lb., will keep water in pump from rising into motor room. The drive shaft passes through center hole; three small holes provide access to oil reservoir in pump.



Railroad flat car is needed to move lower cover to shop for final machining. When finally in-

stalled, it will be attached to suction elbow bringing water from Lake Roosevelt to the pump.





New train, one of three built, has six pneumatic-tired coaches and standard-wheeled engine.

Fast New Train Runs on Tires

ROLLING on pneumatic tires, a French six-coach train of new design makes high-speed travel luxuriously joltless and quiet. Cars have 20 wheels apiece, each with a tire riding on top of the rail with an inner metal flange to guide it. Tires have tubes and are rim mounted. A flat need be changed only at the end of the run, the other tires easily taking the load meanwhile. Separate electric rail-contact shoes and axles close track signal circuits. Tires are inflated to between 120 and 140 lb. per sq. in. Each carries a load of more than 2,600 lb. and has a life of about 21,000 miles. Going at 50 m.p.h., the train can stop in 390 ft., thanks to its light weight and the way the tires grip the track, three times as well as steel.



Speeding at 75 m.p.h., passengers can converse without raising their voices. Pneumatic tires and rubber vestibules between coaches get credit for quiet and comfort. Easy riding qualities permit lighter car structure. Elimination of noise insulation also saves weight. Thus load reduction required by pneumatic tires is partially made possible by the tires themselves.

Pneumatic tires roll over the rail joints without a jolt. Shoe, between tires, works signals.



Gus Clears




While Harcourt stood by and watched, Gus first checked the gas line and fuel pump.

an F.B.I. Suspect

Even as you and I, a G-man can run into a snag. But a

fast bit of headwork by Gus gets this agent off the hook.

By Martin Bunn



GUS WILSON slipped the socket wrench into a pocket of his coveralls, wiped his hands on a wad of waste, and took the identification card the young man offered him.

"F.B.I.," Gus said.

"That's right," the man answered, pocketing the card.

"Okay, Mr. Harcourt," Gus said. "What can I do for you?"

"I'd appreciate your help in a matter I'm looking into. Know the Acme plant?"

Gus nodded.

"Know what they're doing there?"

"Heard it was something hush-hush."

"That's putting it mildly," Harcourt grinned. "Anyway, here's my problem. A little after midnight last night, someone tried to break into the department of the plant where top-secret work is done. If he'd succeeded . . . well, it wouldn't have been so good."

"But where do I come in?" Gus asked.

"I'm getting to that," Harcourt went on. "There was a slip-up last night when the late shift of plant guards came on duty at midnight. Man named Joseph Swinton, a retired cop, was late. By the time he got there in a taxi—at 12:30—the excitement was over. The break had failed and whoever tried it had made a getaway."

"I still don't see where I fit in," Gus said.

"Swinton lives in a tourist court near here," the agent said. "His story is that he couldn't start his car and had to call a taxi to take him to the plant. I'd like you to check over his car and see what's wrong."

"I'll take a look," Gus said.

"The whole problem hinges on that car," Harcourt explained. "Did the person who tried to break in know that Swinton wouldn't be on the job? If so, how did he know? And, most important, was it true that Swinton couldn't get his car started?"

"Maybe I can tell you and maybe I can't," Gus said. "Lots of things could have been done to that car between midnight and now."

"I think we've got that pretty well covered," Harcourt remarked quietly. "I got to the plant just about the time Swinton did. The first thing I did was send a man to the auto court to keep an eye on the car. No one's touched it since then."

"That'll help," Gus said.

"Got time to take a ride out there and look at it?"

Gus glanced at the clock. "Let's go," he said.

The Wrong Cottage

As Harcourt and Gus drove up to the Hill-top Tourist Court, a maid was walking across the crescent of lawn in front of the office. Harcourt asked for the Swinton cottage.

"That one." She pointed vaguely.

Harcourt stopped at the first cabin that had a car parked near by. They got out and stepped up on the tiny porch. Harcourt rapped on the screen door. The wooden door was open. While they waited, they stood looking into the room. A wrinkled suit and shirt lay where they had been tossed into an open suitcase. On a bureau top were the contents of a man's pockets: a wallet, notebook, about a dollar in change, pocketknife, pliers, and a handkerchief.

"Sounds like he's taking a shower," Harcourt said.

Just then a man called from the porch of the next cottage. "Over here, Mr. Harcourt."

The G-man laughed. "That's Smith, my assistant. He must think he's working with a hot-shot cop. Can't even find the right house."

"And in broad daylight, too," Gus laughed, as they walked across the lawn.

Inside the second cottage they found a heavy-set, elderly man slouched on the edge of the bed. Smith held the door open for them. As they entered, the man got up.

"This is rough on me, Mr. Harcourt," he said. "I've got a good record and I don't want any bad marks on it now."

"Routine investigation," Harcourt told him. "Got to go through with it. You know that, Swinton. . . . This is Mr. Wilson. He's an auto expert. Mind if he looks over your car?"

"It's all right with me," Swinton answered.

Smith handed the car keys to Gus. As Harcourt and Gus walked outside, the agent told Swinton and Smith to wait.

The car was a postwar coupe. Gus slid behind the wheel. When he pressed the but-

ton, the starter motor turned over but the engine didn't fire. After several tries, Gus cut the switch, first noting that the ammeter registered when the ignition was on. While Harcourt stood by and watched, Gus raised the hood and looked over the engine. It was spotlessly clean and evidently well cared for.

"Got any ideas?" Harcourt asked.

"Not yet," Gus told him. "Could be any one of several things."

At the carburetor end, Gus disconnected the gas line leading from the pump. He pushed the manual button on the starter solenoid and a little gas squirted out as the engine kicked over.

"Getting gas to the carburetor," he commented as he reconnected the line.

Next Gus turned to the ignition system. With the switch on and the solenoid button pressed, he used a screwdriver to check for a spark at a plug. There wasn't any. Gus flipped down the distributor-cap springs and removed the distributor cap.

Where's the Spring?

"There's the trouble," he pointed. "The rotor spring's broken off. The distributor just isn't getting any high-voltage juice to distribute." He pulled off the rotor and showed it to the G-man. The little blue-steel spring leaf designed to make contact with the central cap lead was snapped off short.

"That happen by itself?" Harcourt asked.

"Every now and then," Gus answered. "It sometimes happens that a spring will just snap. But it's not very likely, especially on a fairly new car."

"Could someone have done it deliberately?" the G-man asked.

"Sure," Gus said. "Say, wait a minute. Someone *must* have broken it."

"What do you mean?" Harcourt asked.

"Take a good look at the broken end. See how it curls up a bit just at the break? That shows it was bent upward until it snapped."

"We figured something like this might have happened," Harcourt remarked quietly.

"Maybe we can check on it further. Just a minute." Gus bent close over the open distributor and fingered the points cautiously. Then he straightened up, nodding his head.

"If it just broke, the broken leaf would have to be in the distributor. That little piece of spring isn't here."

Harcourt frowned. "So Swinton could have disabled his car to have a good excuse not to show up at the plant on time. Let's go see him."

Harcourt led the way back to the room. Swinton was sitting on the bed looking worried. Smith was reading a crime comic book.

"Do any work on your car yesterday?" Harcourt asked.

"Work?" Swinton repeated. "Same as I do every day—shined it up a little. I like to keep a car looking good."

"Mechanical work, I mean," the G-man said.

Swinton shook his head. "Haven't had the hood up in a week until she wouldn't start last night."

"Keep your car locked?"

"No, I don't," Swinton replied. "I'm always around when the car is."

"What did you do last evening?" Harcourt asked.

Found: One Broken Spring

"Read the paper and listened to the radio until about nine-thirty. Then I played three games of pinocle with Jackson. He owns this court."

"Did you play here?"

"No, we played in his room back of the office."

"Check that," Harcourt told Smith.

Smith hurried out and Harcourt led Gus out of the cottage.

"You're sure it couldn't have been an accident?" he asked Gus in a lowered voice.

"That's right," Gus said. "If that spring had snapped of its own accord, the broken part would still have been in the distributor."

Harcourt rubbed his chin and looked thoughtful. He glanced back into the room at Swinton, who had resumed his seat on the bed.

"I guess I'm going to have to hold Swinton."

"Wait a minute," Gus said. "Remember the wrong cottage?"

Harcourt nodded.

"There was a lot of stuff scattered on the bureau," Gus went on.

"I didn't pay particular attention," Harcourt said. "A wallet and some change and . . ."

"And pliers," Gus finished. "That stuck in my mind because most people don't carry pliers around. Let's go take a look."

They hurried to the cottage to find the occupant—a broad-shouldered blond man—packing his suitcase. The articles still were on the bureau. Harcourt rapped and showed his card.

"Just a routine check. Mind identifying yourself?" he asked mildly.

The man admitted them. Then he handed his wallet to the agent. Gus idly picked up the pliers and opened them.

"Good tool you have here," he remarked. "Used it lately?"

"Yeah. I pulled out a nail some dope'd driven into the wall. Pretty near ripped my hide on it," was the answer.

Gus moved toward the door, casually holding a bit of blue steel before Harcourt's eyes.

The big man wheeled and slammed into Gus, who, ready for him, blocked a wild swing. Harcourt grabbed him from behind and expertly pinioned him against a wall.

The door nudged open behind Gus's back. "Swinton's story checks," reported Smith, entering. "From the noise, I thought maybe business was good in here."

The big man, all fight gone, didn't resist the handcuffs.

"Looks like I was lucky when I bumped in here, and you were smart," the G-man said after Smith had hustled the prisoner away. "How did you know where to find that bit of broken spring?"

"That's where I was lucky," Gus grinned.

"It was just a long shot that paid off. When plier jaws are greasy, they may hang on to any small, light thing they've gripped. Guess I just didn't want to believe Swinton had done it. I'd hate to think a guy who keeps an engine that clean could be a crook." **END**





What About

Sound deadening and rust prevention are its major advantages. Here are points to look for if you are planning to have the job done.

Steam cleaning, at the left, removes dirt, grease, and rust scale before undercoating is applied. When the car is new, this may not be required. Car must dry thoroughly.

THESE PARTS SHOULD BE COATED

THESE PARTS SHOULD NOT BE COATED

FENDERS

GREASE FITTINGS

SPLASH PANS

OIL PAN

FLOORING

TRANSMISSION

ROCKER PANELS

MUFFLER

GAS TANK

DRIVE SHAFT

FENDER SKIRTS

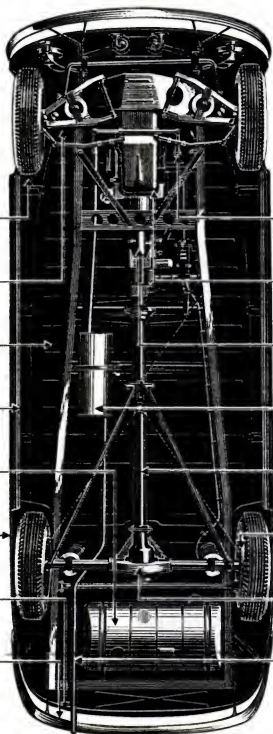
BRAKE SYSTEM

GRAVEL DEFLECTORS

REAR-AXLE HOUSING

INSIDE BACK BUMPER

TAILPIPE



Undercoating?

By R. P. Stevenson

PS photos by Hubert Luckett

WHAT can you expect from undercoating? Does the job pay on an older car? How can you tell whether the material has been properly applied?

Sooner or later, you'll probably wonder about such points. Undercoating, the practice of spraying the belly of a car with an asphalt material, popped up just before the war. It has now become big business.

Drop into almost any large garage these days and you are likely to get a sales talk about it. If you buy a new car, the dealer probably will suggest undercoating, often with considerable enthusiasm.

This enthusiasm is understandable. At \$35 to \$50—the price you pay—the garage can do a good job and turn a neat profit.

Undercoating fills a real need. There's no doubt of that. Think back a bit over the years. Chances are you have given little attention to the grimy expanse of metal underneath your car. Rust prevention in this neglected region is one big point on which undercoating is sold.

Sound deadening is another. Sprayed into cracks and crevices under the car, the material hardens and keeps metal from rubbing against metal. Sealed in, the body bolts and nuts aren't likely to loosen. Many squeaks and rattles disappear. Road and motor noises are muffled.

On a lighter car, the noise-killing effect of undercoating helps give a big-car feel. Drumming sounds lessen or stop. And by sealing cracks in the flooring, it keeps dust from swirling into the car.

Spectacular reports are sometimes heard about the way undercoating prevents rust. For instance, there's a story about a group of factory workers who parked their cars on a lot where chemicals had been dumped. Fenders rotted out in a matter of weeks. Undercoated cars parked in the same lot showed no sign of corrosion.

Generally speaking, undercoating has greatest value as a rust preventive in coastal regions. Salt-laden sea air always lends a hand to corrosion. Undercoating also gives

protection when chemicals are used to clear ice and snow from streets. The same is true in areas with corrosive soil conditions—in desert regions, for instance.

Materials used for undercoating vary considerably in their makeup. Almost without exception, all the 20 or so commercial brands of undercoating now on the market have an asphalt base. Other ingredients, however, vary with the brand.

Recommendations offered by the manufacturers for applying their materials all follow the same general pattern. But you will note a difference of opinion about the question of thickness.

Some specify a 1/8" coating. This, they contend, is necessary to provide adequate sound deadening and protection against the abrasive action of flying gravel, sand, road-top dirt, and other debris.

Others argue that 1/16" is enough if their particular product is used. To buttress this claim, they offer reports on controlled abrasive tests showing their product equalled or surpassed that of a competitor.

Keep this debate in mind when you order an undercoating job. If the manufacturer of the product being used stipulates 1/8", let the garage know you expect that thickness. Some operators in the past have tried to get too many coatings out of a single barrel of material.

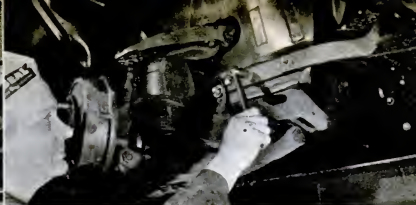
Two general kinds of undercoating are available. In one, the asphalt and other ingredients are carried in a water solution. After application, this type must stand overnight or longer before the material will have hardened enough so that the car can be driven away.

The most common type, however, has an inflammable solvent that evaporates quickly. Undercoatings of this kind set in a few hours, although it may take several days for thick areas to harden thoroughly.

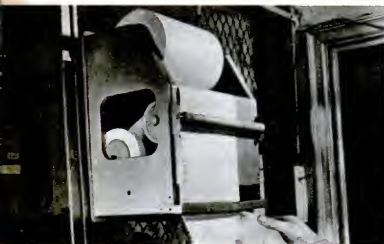
In a wet state, all solvent-vehicle undercoatings are inflammable. Smoking, an open flame, and welding are taboo in the vicinity of a spray operation. When the solvent has



1. The grease fittings are gone over with a gun if the car has been steam cleaned. Steam always knocks out part of the grease. In some cases, greasing might be left as the final step.



2. Body bolts must be tight, for undercoating material will cover them up. Sealed in, bolts are less likely to loosen. Note that wheels have been taken off to give more working space.



5. Paper dispenser speeds up the masking job in shop where these photos were taken. Gummed tape from small roll automatically attaches to edge of masking paper as latter is pulled.



6. Adjusting equipment, operator is now ready for the actual spraying. Fairly high pressure is necessary to get a good flow from the gun. Guns are now made specifically for the job.

completely evaporated, the undercoating material is perfectly safe.

Before any undercoating is applied, the metal areas must be clean and dry. Even a thin film of grease or dust will prevent good adhesion. In time the undercoating material will drop away.

If the car has been on the road for some time, steam cleaning should be the first step. Some dealers, charge extra for this. Such cleaning normally will remove all dirt, grease, and rust scale. But it's advisable for the workman to check over the car, especially the fenders, and scour away any remaining rust with a wire brush or steel wool.

Steam cleaning will knock some of the grease out of the fittings. Consequently, the garage should go over these with a gun before turning the car back to you. Overnight is not too long for the car to dry after steam cleaning.

While the car is drying, the workman can take care of an important preparatory step—body tightening. All bolts and nuts should be turned up fully. You can be virtually certain

the dealer will do this on his own hook. It will save the traditional headache of detecting the elusive squeaks and rattles that frequently crop up a few months after a new car has been delivered.

On some cars, especially those made by Chrysler, you will find a coating of chassis black on certain parts under the car. This is a protective paint made from a residual asphalt. This must all be washed off to let the undercoating adhere properly. A cloth dampened with gasoline or kerosene does the job.

Masking paper applied around the lower edges of the fenders and body in skirt fashion serves two purposes. It prevents overspray from hitting your car or another standing alongside. It also enables the operator to apply the material right out to the paint line along the edges without infringing upon the paint itself.

Undercoating should be applied only to certain parts. The ones to be skipped are as important as those to be covered. Do not let the garage coat the drive shaft, transmission, oil pan, rear-axle housing, muffler, tailpipe,



3. Chassis black, a thin asphalt paint, must be washed from gas tank and other parts with solvent so undercoating material will adhere. Not all cars have this protective paint.



4. Masking paper is attached in skirt fashion around the edges of the fenders and body. This enables operator to spray undercoating out to the paint line without splattering the finish.



7. Undercoating is sprayed with slow, steady strokes to assure even coating. The workman sometimes uses a plastic face shield while doing the job. Spraying takes about an hour.



8. Inside of hood is coated to deaden engine noise. The coating also adds desirable rigidity to the thinner sheet metal found on some new cars. Car can be driven in a few hours.

the brake mechanism, or any of the lubrication points. On most of these parts, the coating would lock in too much heat.

You should be sure, however, that an even, continuous coating is applied to the fenders, fender skirts, gravel deflectors, gas tank, rocker panels, flooring, splash pans, and the inner face of the back bumper. The material should be sprayed extra thick on the joints where a fender meets the body.

The underside of the hood is usually included in the job, but this is up to you. Here, the objective is sound deadening only.

You may have heard that some fleet operators apply undercoating to the oil pan to prevent low-temperature sludge. This is true, and the idea has proved its value on stop-and-go vehicles. But this type of application is not advisable for passenger cars, since the engine would overheat on long runs. In some cases, too, the fire wall is coated. But this demands a lot of finicky masking.

As a rule, a good undercoating job should last the life of a car. But this rule, like others, has its exceptions. Constant driving over

loose-gravel highways may wear through the coating, especially if it has been applied too thin in the first place.

Temperature extremes have no appreciable effect on the better undercoating materials. These usually will not soften to the point of dripping unless heated to at least 300° F. At the other end of the thermometer scale, the materials will not crack unless the temperature drops to around 30° below zero.

Like seat covers, undercoating adds to the resale value of a car. Not only will the prospective purchaser be more apt to like the sound and feel of the car, but the lack of rusted-out spots will be a point in your favor.

You probably have wondered what happens if you dent an undercoated fender and must have it bumped out. Will the undercoating present a problem?

The answer is no. The material is quickly softened by applying a torch to the painted side of the fender. It then can be scraped off the area where the work is to be done. If necessary, body bolts can also be uncovered by torch softening.

END



Open Car Becomes Closed Sedan in One Minute Flat

THIS all-metal convertible, built in England by Col. John Dolphin, can be converted from a smart open tourer to a completely enclosed sedan in exactly 60 seconds.

As a convertible, the roof lies snugly out of sight in the hinged boot. You don't have to be a professional strong man, either, to lift the steel roof into position. It just takes a little nudging, since the weight is neutralized by counterbalances. Two locks on the windshield secure the roof, while rubber sealing makes all joints watertight. Dolphin, who contrib-



uted two important inventions to World War II—a one-man submarine and a folding motorcycle used by paratroopers—built his unusual car around the chassis of an Allard, a standard British automobile powered by a V-8 engine of 221 cu. in. displacement.

Old Motorcycles Race in Great Britain



Two entries in England's 13th annual race of historic motorcycles are shown here. Only machines built before 1915 were eligible. At left is a Beeston Tricycle that was built in 1899, one of the oldest entries. Its engine has a displacement of 10.675 cu. in. Below, an early American-built motorcycle—a 1911 Pierce Arrow—gets away to a flying start with the aid of a couple of willing helpers. The engine, four cylinders in line, displaces 48.19 cu. in.



New Pinch Brakes

Stop the Crosley

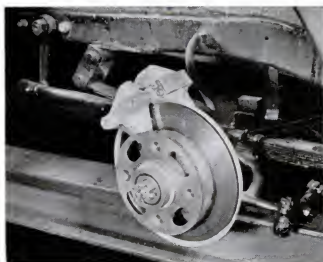
CROSLEY has pulled something new out of the air—a type of brake previously used only on planes. Actuated hydraulically, the brakes consist of small pads of a hard braking material that pinch together on a revolving cast-iron disk when you step on the pedal.

This gives a soft but positive braking action. The brakes were tested for a year before being adopted. The friction surfaces are said to wear very slowly.

Besides the brakes, the latest Crosleys introduce a new engine called the Ciba®. Instead of using brazed steel stampings as in the old 59-lb. Cobra®, the new engine has a cast-iron block. This ups the weight to about 85 lb. In design, the engine is the same, but power is slightly increased. **END**

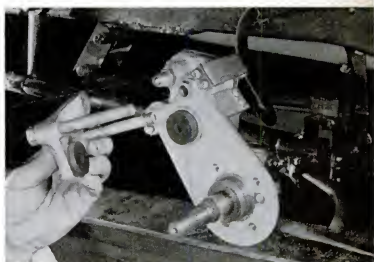
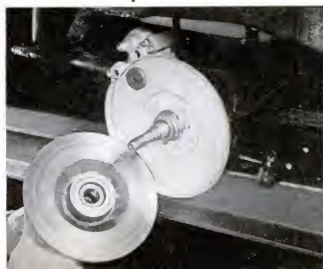


Hand-brake lever in the newer Crosleys is located just under the dash. It sets the new disk brakes on the rear wheels by mechanical linkage. Hand brake was previously on the floor.



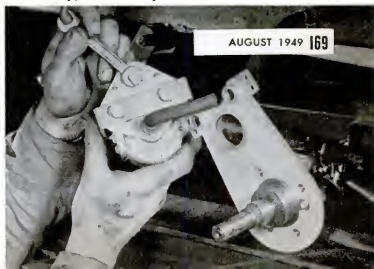
New disk brake is operated by a conventional hydraulic system. Above is what you see when you take off wheel. Disk revolves with wheel.

Dust cover protects inner face of the disk but allows cooling air to circulate. Water and oil are said not to impair the action of the brake.



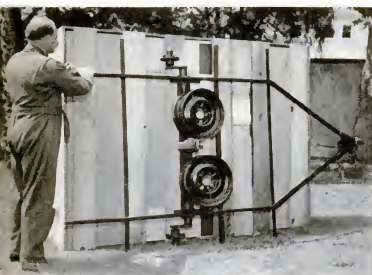
Two pads of braking material about size of half dollar pinch against sides of disk. A spring separates the pads when you release the pedal.

Turning this nut on back of cylinder assembly adjusts the braking pads to proper clearance. Previously, the Crosley used mechanical brakes.



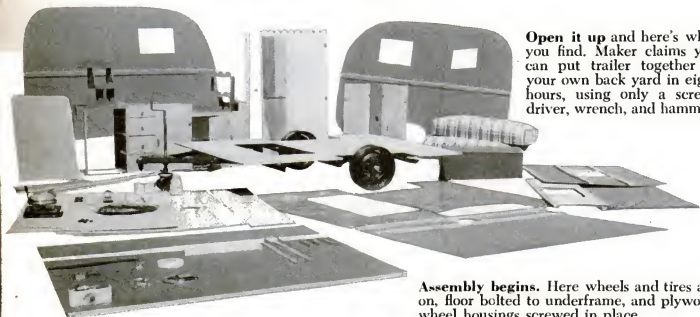


Big one or little, take your choice. Both trailers are sold knocked down for home assembly.



Trailer Comes in a Package

Here's what you get. Crated for freight shipment, big trailer, at left, weighs 1,000 lb. Here, 16" Ford wheels are simply wired to the underframe. Tires and tubes are not furnished.



Open it up and here's what you find. Maker claims you can put trailer together in your own back yard in eight hours, using only a screwdriver, wrench, and hammer.

Assembly begins. Here wheels and tires are on, floor bolted to underframe, and plywood wheel housings screwed in place.

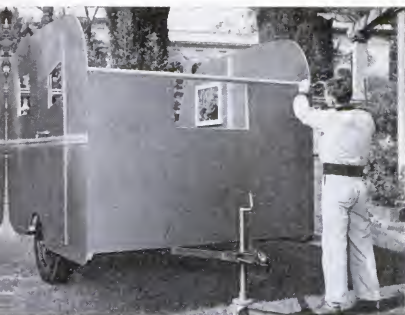


EVENTUALLY, it had to come—a trailer a man handy with hammer, wrench, and screwdriver could assemble in the back yard. Now, Prefab, Inc., of Los Angeles, offers you a choice of two—the Cub Senior® and the Cub Sportsman®.

All you must do is unwire the crate and follow detailed instructions. The parts are all pre-cut and everything is furnished except tires, tubes, and paint.

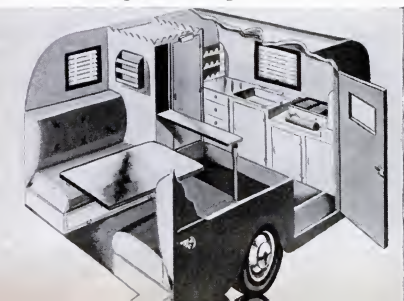
Senior boards the train in Los Angeles at \$395, Sportsman at \$279.50. You pay the freight, but shipping knocked down saves more than half on delivery charges.

The house trailer includes all conveniences for living on the road. The less de-luxe Sportsman, designed chiefly for hunting and fishing trips, has an aluminum body and weighs about 450 lb. A mattress on the floor provides comfortable sleeping.



Walls are nailed temporarily, then permanently secured with screws. All units are predrilled for screws and bolts. Tape is applied over the seams to hide nails and any irregularities.

Four persons can sit comfortably on the seats. Inside, the bigger trailer is 8' long and 6' wide and high. Equipment includes a pull-down ironing board and hinged and screened windows.



Top curves into place after side walls and front bulkhead have been attached. All seams are caulked to keep out water. Sides and top are composition board, reinforced with wood.



In goes the sink assembly. This includes ice box, aluminum basin, and four drawers. Four other assemblies come with the kit—shelves, table, clothes closet, underseat cabinets.

Pulled out, the seats make a double bed. The closet comes already wired for either 6-volt or 115-volt electricity. Detailed instructions make it easy to assemble the trailer.



Low-Cost Convertible Does 30 Miles per Gallon

EXPECTED to sell for about \$1,170 at the factory, this little car is now being tooled up for production in a wartime aircraft plant at San Diego, Calif. The maker is Del Mar Motors, Inc.

Powered by a 4-cyl., 63-hp. Continental engine, the pilot model is said to give around 30 miles per gal. In tests, it has been clocked at 100 m.p.h. Fifty is an easy cruising speed.

Built on a conventional chassis, the Del Mar has a 100" wheelbase and 58" tread. Three models are planned—a convertible, accommodating three persons on the single seat; a two-door, five-passenger sedan, and a three-passenger business coupe.



As designed, the car is to be largely assembled from standard parts obtained from automotive-industry suppliers. The car will use 6.00 by 12 tires.



Oil Filter Has Safety By-Pass

A NEW motorcycle oil filter announced by the Harley-Davidson Motor Co., Milwaukee, Wis., forces the lubricant to pass through a $\frac{1}{8}$ " cylindrical felt filter element. The unit has a ball check valve to by-pass the oil if the element becomes clogged.



Double Mirror Looks Ahead

WHILE you are driving behind a truck or other large vehicle, this device is said to give you a view of the oncoming traffic. Made by Passing Eye, Inc., Kenosha, Wis., it consists of two mirrors on a chrome-plated double arm that clamps to the door.



Reflecting Sign Protects You

NIGHT repairs along the highway can be made in greater safety if you use this new reflecting danger signal. Made of steel, it folds for storage in the luggage compartment. It's painted red, and glass reflecting beads form the lettering. The Veecliff Corp., New York, makes it. Called Steer Kleer®, the sign retails for about \$3.50.

Mechanics and Handicraft

REG. U. S. PAT. OFF.

Five Power Tools in a Box

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Outrigger Boat Is Week-End Job

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Making Draw-in Lathe Collets

PAGE 200

Vacuum-Tube Voltmeters

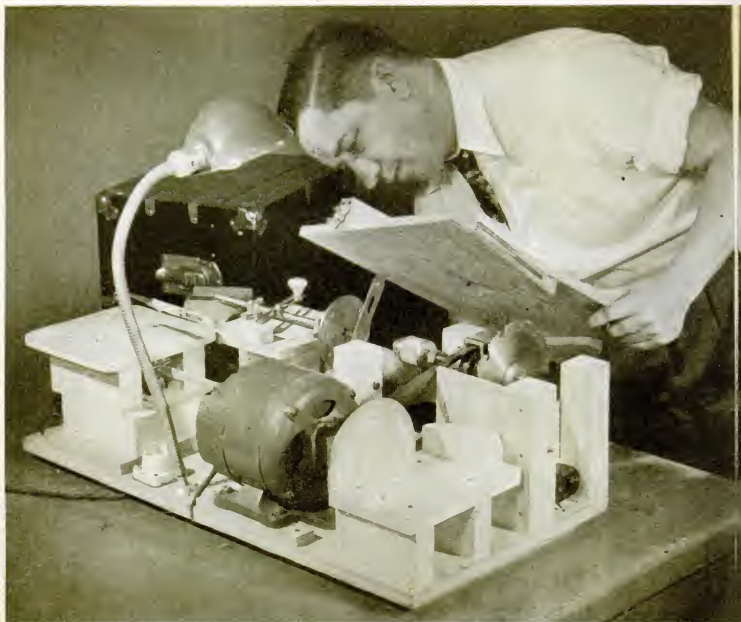
PAGE 210

Air-Conditioning a Car

PAGE 222

Workshopping comes easy with this power-tool rig. Everything fits into a box. See next page.





Popular Science
Practical Solution

Power-Tool Shop

Motor and spindle arbor are heart of five power tools in a trunk

1. You start with this—a plywood panel to fit inside trunk, a $\frac{1}{4}$ -hp. motor mounted on blocks to let 6" sanding disk clear the base, and a polishing head. Note lifting handles.



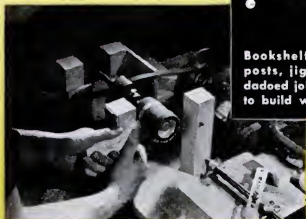
2. Mount table posts with angle brackets and long wood screws. Low plywood wall supports switch; other pieces guard the saw blade. Pulleys take sanding disk and drill pad.



With saw blade removed, this rig does turning, jigsawing, disk and drum sanding, drilling, buffing, wire brushing.



Bookshelf with turned posts, jigsawed sides, daddoed joints is a breeze to build with this outfit.



Builds Itself

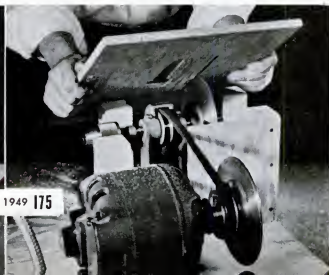
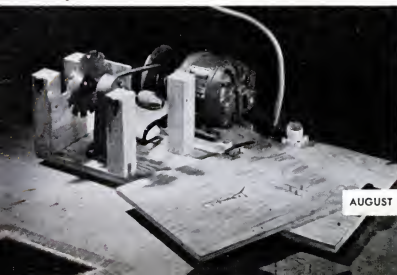
that make real work real fun.

3. Attach leaves of hinges to forward posts. Screw matching leaves to $\frac{1}{2}$ " plywood table with countersunk bolts. Insert removable hinge pins and mark recess for head housing.

"COULDN'T a practical set of power tools be built around a motor and a polishing head?" asked our Editor. "Something a fellow living in an apartment, or even a furnished room, could put to use?"

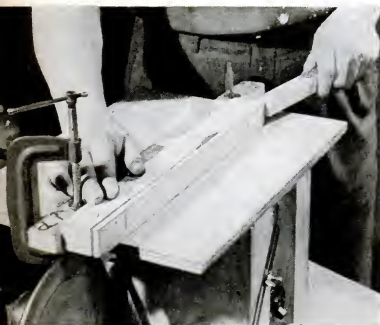
The only answer to that was to try. The result is an eye opener. With electricity

4. Chisel recess and remount 12" by 15" table after putting saw blade on. Lower table slowly to cut saw slot. Widen it to $\frac{1}{4}$ " by filing or reclamping saw to cut a second kerf.





5. Hold straightedge against blade. Measure to table edge at both ends. If edge isn't parallel to blade, plane true. Fit cabinet lid supports and wing nuts as below.



6. Rip fence is ripped to size against temporary fence, a straightedge clamped to table. Raise and lock table to rip groove $\frac{3}{8}$ " deep for clamp rod, as shown in drawing opposite.

7. With finished fence, you can groove $\frac{3}{8}$ " sanding table $\frac{3}{8}$ " deep. Reset fence to widen groove each cut. Note bolt and wing nut that clamp table support on each side.



doing the work, you're free to enjoy the sheer fun of craftsmanship. Difficult dados, recalcitrant rip cuts, and finicky fits become swift routine. You're no longer "too tired to make things" after supper.

Best of all, you needn't turn your pockets inside out. The setup is tailored to slim budgets. And the rig literally makes itself: it's designed to cut and sand its own parts.

Its capacity is necessarily limited. It won't take the place of a 10" tilt-arbor saw, nor handle a bedpost turning, compound miters, or the oak stem of a cabin cruiser. But these are the rare jobs. What it will do is make the many cuts, grooves, dados, holes, and short turnings that are 90 percent of most jobs. It's a natural for modelmaking.

You'll need a 1,750-rpm, $\frac{1}{4}$ - or $\frac{3}{8}$ -hp. motor, costing new from \$10 to \$15. With luck you may find a used one for less, but don't buy any rated less than $\frac{1}{4}$ hp.

As the polishing head is the heart of the setup, it pays to get the best you can within size limitations. The one shown is 6" from mounting surface to shaft center, and has bronze bearings and a single pulley. Needle bearings would be better, of course, and a two-step pulley would give a speed choice for drilling and turning.

Check the shaft for up-and-down play in the bearings (there should be none). All end play should be removed by adding thin shim washers as needed next to the pulley.

You'll need a drill chuck, preferably of $\frac{1}{2}$ " capacity, that will thread on the right-hand end of the shaft, a three-step pulley, and a single small pulley. Brass facings bolted to the pulleys turn them into a sanding disk and drill pad. Instead of brass, you can use $\frac{3}{8}$ " plywood disks, turned true as they spin on the motor shaft.

If you intend to put the outfit into a small trunk, buy a very short V-belt. Should you have more room, spacing the motor and polishing head farther apart will allow more swing over the sanding disk.

The combination saw blade shown does both ripping and cross cutting. Be sure to use regular recessed arbor washers both sides of it, and clamp it securely (the left-hand end of the shaft will have left-hand threads). Always play safe by removing the blade when you do work that requires removal of the saw table. And use $\frac{3}{8}$ " plywood to box in the blade below the table.

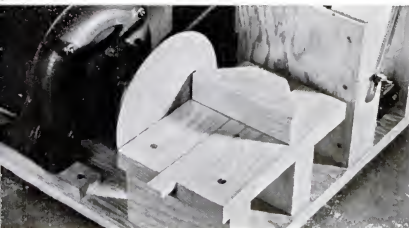
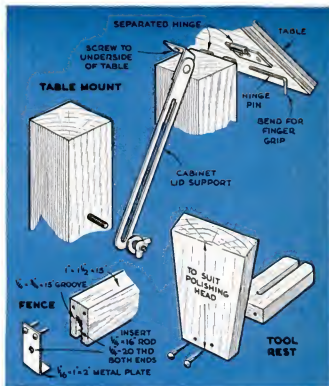
The table shown wasn't grooved. Small stock is cross-cut by holding it against the miter gauge and sliding this along the table

edge. Larger work is handled by clamping a straight strip on crosswise and guiding this on the edge. The same dodge, with the strip clamped lengthwise, enables one to rip stock at settings the fence won't permit.

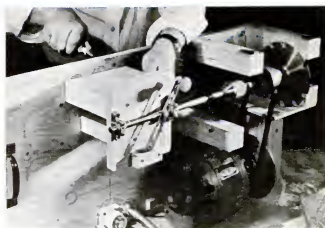
If you want a grooved table, mount a temporary one and clamp on an improvised fence. With this setup, groove the table.

The tailstock bar must be turned or filed to a point, and tapped for a screw that slides in the slotted feed lever. File a sharp cross on the end of a short rod, which you can chuck as a live spindle. Small turnings can be gripped right in the chuck.

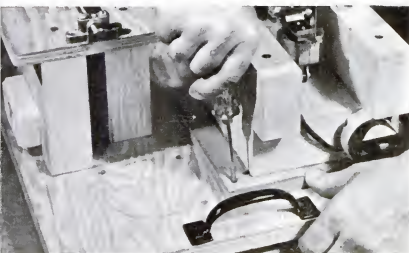
Besides the sponge-rubber pad under the jigsaw, there are two under the base panel. A double outlet mounted in front is for a hand grinder and an engraving tool. The 10-amp fuse protects house fuses. You can unscrew this to prevent children from hurting themselves. All wiring is underneath. END



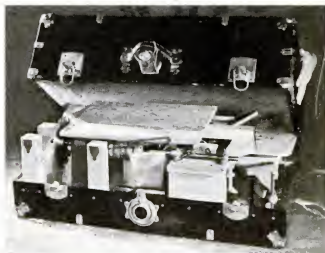
8. Attach sanding table to blocks that raise it to center of disk. Finish table and gauge with wax only. Reversing switch makes motor run backward for sanding on near side of disk.



9. Mount tailstock table on blocks. Put $\frac{1}{2}$ " rod in chuck through pillow blocks to align them. File cap of one block so it clamps spindle when tightened. Pivoted lid support is feed lever.



10. Magnetic jigsaw is hand type mounted on blocks atop sponge-rubber pad. It has plywood table 8" square. Switch is on base. A double outlet is mounted on tailstock at left.



11. Everything fits, including vise at corner. Gooseneck lamp is bent down, saw table detached and laid lengthwise. Trunk base becomes lid, removed like table by pulling hinge pins.



Touches of brass and a clear-plastic handle set off copper. The peened areas add contrast.

Silent Butler in Two-Toned Metal

By Bill Luther

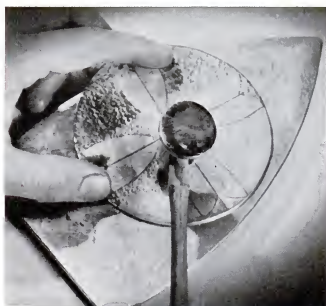
DURING a party, you *could* empty the over-flowing ash trays into a bucket, but a silent butler makes a better impression. This one presents a handsome appearance but isn't very difficult to make.

Four brass petals and a center brass ring on the cover stand out against peened and burnished copper. Round brass wire, soldered in place, creates a clean dividing line between the plastic handle and its copper socket.

All other parts are copper. Get soft cop-



Form body from 1½" by 12" strip of 20-gauge copper. File the ends square, bind band temporarily with wire, and silver-solder together.



Peen the copper top outside the spaces to be occupied by petals. This rough texture makes a pleasing contrast to the burnished petals.

per if you can. Otherwise, anneal the stock before working. Form the circular body from a 1½" by 12" strip of 20 gauge sheet, flattening the metal well before bending. Silver-solder the joint.

The spiral decoration around the bottom consists of two pieces of 1/16" square copper radio bus bar twisted together. Before twisting, roll up the pieces, heat red hot, and plunge into dilute sulphuric acid. This removes the tinning coat.

Clamp the ends of the wires in a vise and twist into a tight spiral. Wrap around the body and saw to the correct length, matching the twists to make an invisible joint. File the ends square and join with silver solder. Cut and solder together a ring of this square wire to finish off the top edge of the pan.

After cleaning the outside surface of the body band, tin the edges lightly with soft solder. Also lightly tin the inner faces of the decorative rings. Slide on the band and sweat-solder in place.

Cut a 3¾" disk from 20-gauge copper for the bottom. Flatten, tin the edge, and sweat into place. The handle socket is a 1" length of ¾" o.d. copper tubing. After soft-soldering a ring of 1/16" brass wire around one end, sweat the socket to the body.

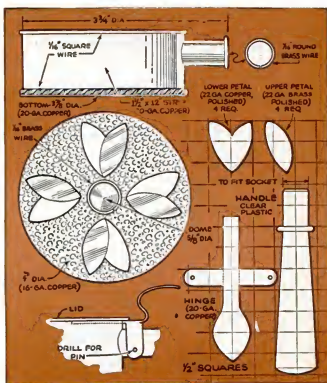
The top is a 4" disk of 16-gauge sheet copper. After tracing off the outline of the top decorations, peen all areas outside these lines. At the center, form a ¾" dome, using a round-ended punch on a lead block. Around the dome solder a ring made from 1/16" brass wire.

Tin the backs of the brass petals and half the tops of the copper ones. Sweat these units together. Then sweat to the cover.

After cutting and bending the hinge to shape, file a shallow notch in the edge of the body just above the handle socket. Use the hinge itself as a guide. Sweat the hinge to the underside of the lid.

Turn the handle from 1" clear plastic rod. Polish with soft rag buffing wheels, using a light pressure and white buffing compound. Finish with a clean wheel and no compound. The handle should fit snugly in the socket. It is secured by the hinge pin, made from heavy copper wire.

Polish all the metal parts to a mirror finish, using tripoli followed by rouge. Clean off the polishing compound with solvent and hot soapy water. Then apply a coat of clear lacquer. When dry, push in the handle and peen the pin. END



Snip the bottom petals from thin copper, top ones from brass. Thoroughly flatten all petals before sweat-soldering them in place.

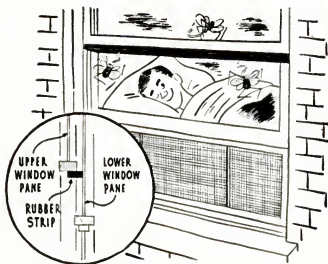


File a slot in the top edge of body above the handle socket to admit the hinge shank. This permits the lid to fit down flush on the pan.

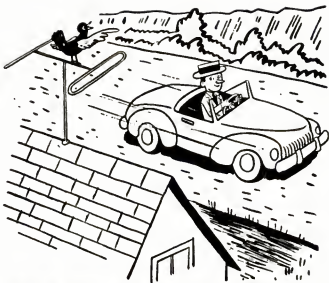
What's Your Ingenuity Quotient?



My personal snorkel, the hose and extension on a tank-type vacuum cleaner, is wonderful for retrieving small objects dropped into inaccessible places. Tie a piece of gauze over the nozzle to keep the article from going into the tank when the suction picks it up. Don't use this for picking up something from an aquarium (you may lose the guppies), or for cleaning a canary cage (you may get the bird).—*Pat Fey, Columbus, O.*



My bedroom seemed like an air base for three fighter squadrons of mosquitoes. Once landed, they took me for a blood bank. I had fit-in screens on the windows but the bugs flew in the gap between the upper sash and lower pane. Then I tacked a rubber strip along the lower edge of the upper sash to block the opening. Now I sleep without swatting or spraying insect dope.—*Joseph Shulman, Brooklyn, N. Y.*

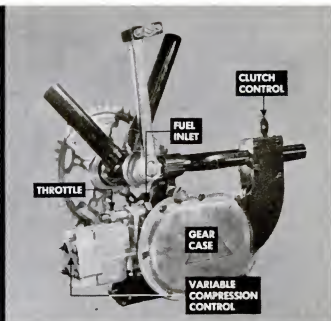
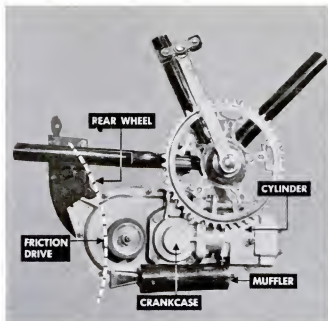


Show me the video home. I was driving in to the city and ducked off the main highway to escape heavy traffic. Soon I was hopelessly lost. After driving around side roads and lanes for awhile, I suddenly thought of the TV aerials. The dipoles are set up facing toward the stations, which in my area are in the city. By following the dipoles, I soon was on my way home.—*Walter Katig, Manhattan, N. Y.*



Paddling your own kayak is fun—but not when dripping water from the blades runs down your sleeves. After an hour of paddling, you get sort of soggy. I solved the problem for about a tenth of what regular drip cups would have cost. Cutting the centers out of 1½" sink stoppers, I forced the rims over the takedown ferrules and up to the blades.—*J. B. Ehrhardt, Madison, N. J.*

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works. Use government postcards only. Contributions cannot be acknowledged or returned.

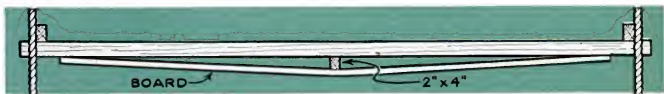


Midget German Diesel Motorizes Bicycles

A LIGHTWEIGHT bicycle motor that will run on almost any fuel from heavy bunker oil to kerosene is being manufactured by the Lohmann Company, Bielefeld, Germany. Main feature of the 11-lb., two-cycle engine is its economy of operation; fuel-tank capacity is $\frac{1}{2}$ gal., said to be good for 100 miles. A Diesel, it has no electrical system, ignition being effected by compression heat. A handle-bar control allows compression to

be varied from 1-to-70 for starting to 1-to-50 for running. Bore is 27 mm., about $1\frac{1}{8}$ ".

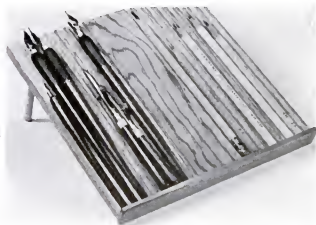
Made for bikes weighing 22 to 28 lb., the motor is simply clamped on, leaving the pedal drive unaltered. A friction roller transfers power to the rear wheel. On a level the 0.6-hp. motor gives speeds from 1 to 12 m.p.h., and it's said to take a 7-percent grade with ease. Arrangements have not been completed for its distribution here.



Cantilever Reinforcement Makes Scaffold Safer

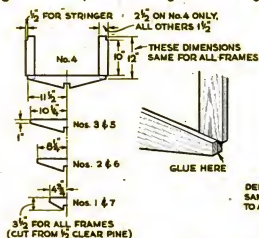
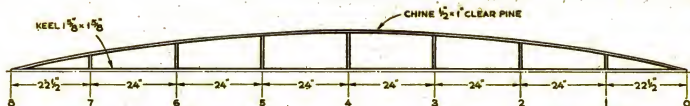
DON'T take chances with weak or springy scaffolds. One carpenter makes his hanging platforms safer by the method shown above.

For a single-plank scaffold he nails a two-by-four cleat across the center of the plank. A long board is bent over the cleat and nailed at both ends. Two-plank scaffolds require only two cleats across the double width.—Victor H. Lamoy, Upper Jay, N. Y.

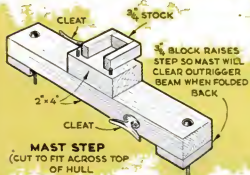
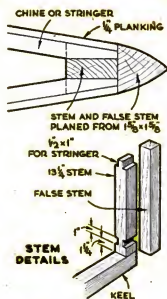
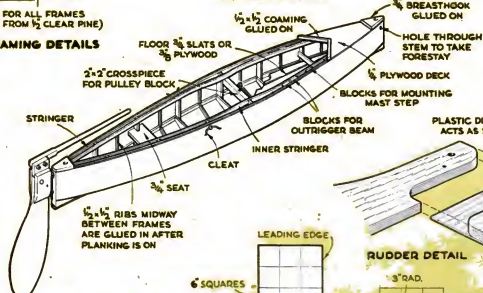


Rack Keeps Pens and Pencils from Rolling off Table

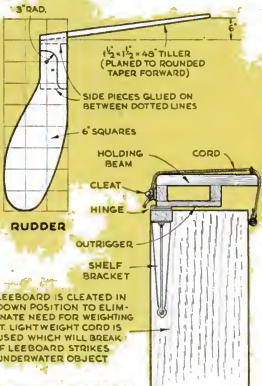
YOUR drawing table won't be as cluttered if you keep pencils and other drafting tools arranged in this wooden rack. The board is $7\frac{1}{2}$ " by $7\frac{1}{2}$ " with $\frac{1}{8}$ " grooves routed as shown. A $\frac{1}{8}$ " by $\frac{3}{4}$ " strip in front acts as a stop, and the slant is provided by two $\frac{1}{4}$ " by $2\frac{3}{4}$ " dowels in back. The rack lines the pencils up for easy selection and prevents them from rolling off the desk or under the work.—Glenn A. Wagner, Delmar, N. Y.



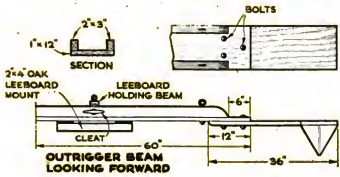
FRAMING DETAILS



RUDDER DETAIL

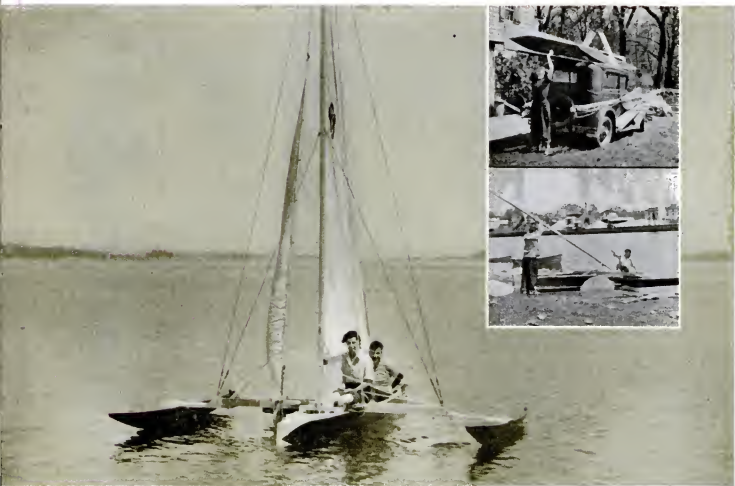


DETAIL OF OUTRIGGER BEAM AND LEEBOARD



LEEBOARD IS CLEATED IN DOWN POSITION TO ELIMINATE NEED FOR WEIGHING IT. LIGHT WEIGHT CORD IS USED WHICH WILL BREAK IF LEEBOARD STRIKES UNDERWATER OBJECT

-PATRICK-



Light and fast, this three-hulled craft will quickly put you under sail, whether you live

near salt water or fresh. Built for easy dismantling, she can be carried for miles on a car.

Outrigger Sailboat Built in Week End

By **George Daniels**

HERE'S a fast little boat you can stick together in a couple of days. The secret of the speedy job is a synthetic-resin adhesive. This provides a bond stronger than the wood itself and so waterproof that you could boil the joints all day without causing them to weaken.

The boat belongs to the class of fast sailing craft sometimes dubbed trimarans. She's so light a mere whisper of a breeze is often enough to move her. In a really good breeze, you'll streak along like a speedboat—without heeling more than a few degrees. If becalmed, the boat's light enough to paddle.

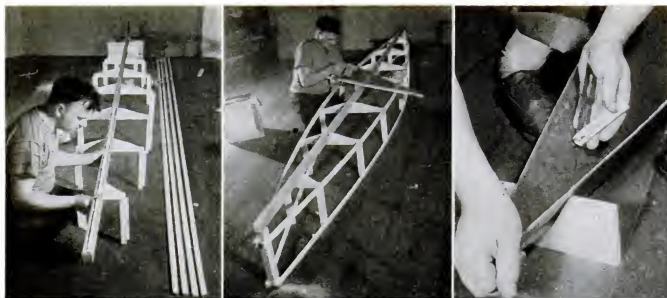
Little work space is needed. The hulls are so narrow you can build them in the house, upstairs or down, and slide them out the window. I worked in our living room,

winding up the entire job in one week end.

Several waterproof adhesives suitable for boat work are on the market. Mix just before use and apply with an inexpensive paint brush, coating both of the surfaces that are to be joined. When you are through, wash the brush in cold water.

At ordinary temperatures, the glue will set hard overnight. But you can speed up the job by putting the glued parts in a room heated to 85° or 90°. For instance, the main hull frames for this boat were cut and glued in the morning, hardened in a hot kitchen during the day, and fastened to the lengthwise pieces—the keel, chines, and stringers—in the evening.

Cut the hull frames as the first construction step. You'll note from the drawing on the facing page that two frames of each size are required, except in the case of the middle



Glued frames for the main hull are spaced at 24" intervals along keel (above left). Guide cuts for beveling the keel and chines are made with a saw (center). Battens are clamped to

the sides of the saw to keep it from cutting too deep. V notches cut at a 60° angle in several pieces of scrap stock (right) keep the pontoon planks aligned while glue is setting.

one. For the latter only, use side members 2½" wide.

Clamp the parts together until the glue has set. If you haven't enough clamps, drive a brad or two through the pieces. You can pull these out later if you wish.

In assembling the hull frames, align the upright members and the bottom piece carefully with a try square. This is important, for after the glue has hardened it won't be possible to make changes. Use newspapers to keep the glued parts from sticking to the floor or workbench.

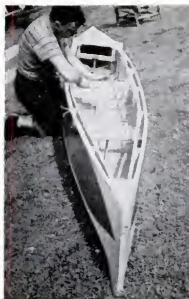
When the frames have set, glue them and the two stems to the pine keel. For added strength, join the stems to the keel with ¼" dowels, or perhaps simply a nail driven through the keel into the base of each stem. Also glue the chines and stringers in place, tying them and the frames with heavy cord until the glue has set. Be sure all elements are properly aligned before setting the hull frame aside to dry.

Then turn to the pontoons. Use battens to lay out the side and top planking to the dimensions given on page 186. In the origi-



Two hinges bolted together join the boom and mast (left), allowing the boom vertical and horizontal movement. A plastic drink stirrer (center) serves as shear pin for the rudder.

Leeboard cross arm, a length of two-by-four, is marked (right) for two brass door hinges that hold it to the outrigger beam. Here the leeboard is seen in the up position.



Main hull presents trim appearance as it nears completion (left). Note the large screw eyes in stern. A pin dropped through these and two mating eyes in the rudder hold rudder-tiller

assembly in place while boat is in use. Mast is mounted on its step with a hinge (right), permitting mast to be walked up. Two bolts in the step allow removal of hinge and mast.

nal boat, these parts were cut from $\frac{1}{4}$ " mahogany veneer, but $\frac{1}{4}$ " waterproof plywood could be used just as well.

With a block plane, bevel the bottom edges of the sides to about 60° . You don't need to worry about the bevel being exact since the glue will fill in small gaps. Also cut the nose blocks and the two 60° bulkheads on which the outrigger beam is to be mounted.

Coat the beveled surfaces of the sides with glue and join them by driving in a few brads. Cut 60° V notches about 3" deep in several blocks of scrap wood and rest the glued sides in these. Glue in the nose blocks and two center bulkheads.

Other frames for the pontoons are simply cut to length and stuck in place with glue. It's not necessary to notch or fit them. The gap-filling qualities of the adhesive will take care of this.

When the sides have set, plane off the upper edges so the top panels will lie flat for gluing. You will notice at this point that the top edges have a definite upward curve near the ends. The top planks will easily conform to this curve if drawn down at the center with cord.

Before gluing on the top panels, apply a good boat paint to the inner surfaces of the top and sides, leaving unpainted strips where glue must be spread. Glue on the 1" by 12" by 36" tongue for the outrigger beam at the same time you are attaching the top panels.

By now the main hull frame should be fully dry. The side planks go on first. These

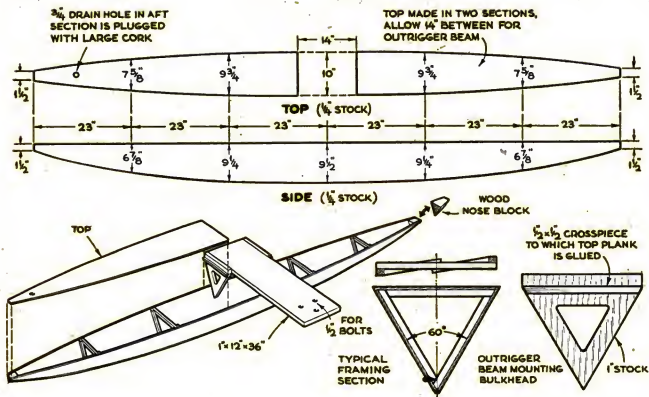
are straight lengths of $\frac{1}{4}$ " mahogany 12" wide in my boat, but $\frac{1}{4}$ " waterproof plywood could be used. Since the curve of the sides is so slight, very little beveling is necessary on the edges of the frames. Here again, the glue saves you time by making an exact fit unnecessary.

Tie the side planks in position temporarily and mark on them the position of stems, side frames, stringers, and chines. Then remove the planks and apply glue both to the framework and planking. At this point, it's best to have a helper in applying the glue so it won't begin to dry on any part before the plank is set in place.

If you use partly driven brads to hold the planks to the chines, you will find it possible to apply the bottom planking before the sides have set. Bevel the lower edges of the side planks and the keel so the bottom planks will fit flat. Try these in place before applying the glue, and be prepared with enough clamps to hold the twisted portions at each end of the boat.

If your bottom planking is not plywood, the stresses may cause it to develop a split or two. But don't let minor splits worry you. A little glue will seal them. As the final step in the planking job, glue on a rub strip, holding it in place with partly driven brads. When the glue has set, pull these out and plane down the strip.

Then turn the hull over and glue in $\frac{1}{2}$ " by $\frac{1}{2}$ " reinforcing ribs midway between the frames. Floor the boat with slats or plywood, glue in a seat cut from $\frac{3}{4}$ " stock, and



Pontoons are bolted to the outrigger beam. This allows dismantling boat into smaller units.

follow with blocks for mounting the mast step and outrigger beam. Install a 2" by 2" crosspiece at No. 4 frame for the pulley block, and add the inner stringers. The forward deck can be glued on, but you may prefer screws to give access for seasonal painting.

Glue up the outrigger beam, using two lengths of 2" by 3" fir for the side members.

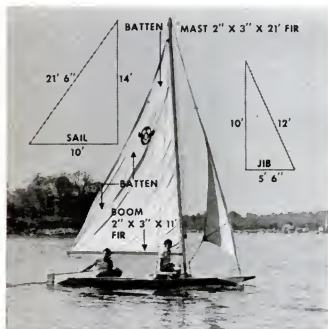
This beam allows some flexing, preventing any excessive twisting on the lightweight hulls. Like the mast step, the beam is attached with bolts for easy removal. Removing these parts allows the hull to rest flat on the car top.

Shape the leeboard and rudder from 1" white pine. Only one leeboard is used, since this kind of boat doesn't heel enough to lift out of the water to any appreciable extent. In the original boat, the leeboard was mounted on its oak crosspiece with heavy shelf brackets. If the boat is to be left in the water, however, it would be advisable to use straps of 3/4" bronze bent to a right angle instead of steel brackets.

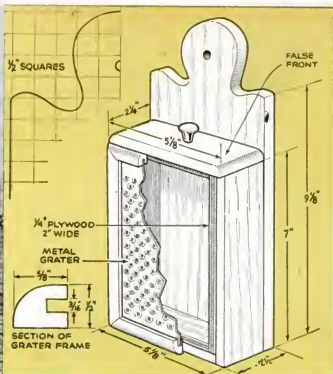
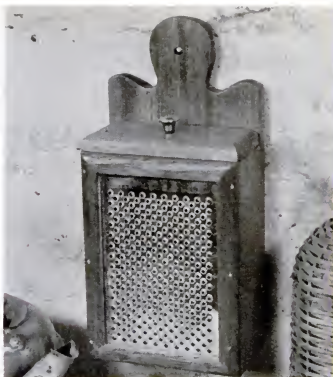
If you find it necessary to splice a mast, take special pains with the joint. Cut the two pieces at an angle and clamp firmly while the glue is drying.

The finish consists of clear varnish on the main hull sides and on the pontoons, yellow enamel on the bottom, trim, and the spars. A secondhand Comet sail will serve very nicely if you are not prepared to buy a new one this season.

One advantage of the boat is its portability, allowing you to pick and choose sailing locations. The main hull weighs only 75 lb., the pontoons less than 30 lb. each. Dismantled, the boat has often been carried 50 miles atop a car. **END**



Boat is rigged like this. The jib is run up on the forestay. Stays are stainless steel sash cable. Three battens are in the sail.



Cheese Grater Catches the Crumbs

IF SPAGHETTI is a specialty in your home, you'll want this attractive grater for the dry Italian cheese that tops it off. The grater does a fine job, too, on bread crumbs and other dry foodstuffs. The gratings fall into a drawer, ready for use.

First obtain a suitable grater. Its size determines dimensions of the box and drawer. I used the common half-round type, snipping off the ends and then flattening it. Dimensions in the drawing are suited to the grater that I had.

All wood parts were cut from $\frac{1}{2}$ " stock with the exception of the body of the drawer. This is $\frac{3}{4}$ " plywood. The drawer pull is a small five-cent knob.

Begin by making the grooved molding

that frames the grater, modifying the dimensions given if necessary. Lay out a pattern for the back and cut to shape. Drill a hole for hanging up the grater. After cutting other parts, assemble with glue and small brads. First join the sides to the back. Then butt the bottom between the sides. After tacking the molding to the sides and bottom, slide in the grater, and put the top part of the molding in place.

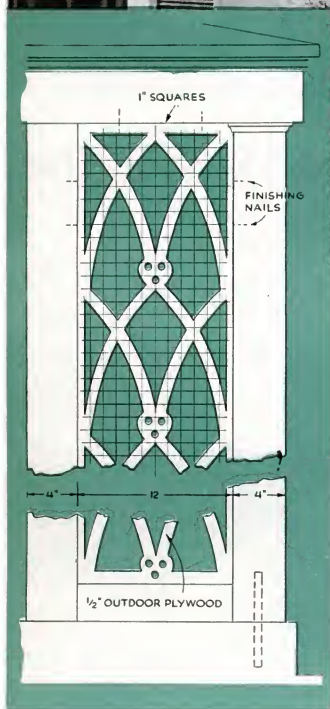
Butt joints also are used for the drawer. Glue on a false front and strengthen it with brads driven from the inside.

Round all edges with a rasp or coarse sandpaper, finishing with fine sandpaper. The wood parts may be stained or left natural.—Doris Aller, San Francisco, Calif.



Metal grater fits into a $\frac{3}{16}$ " groove cut in the frame molding. If cutting this presents any difficulty, you may be able to buy suitable molding already grooved. The molding is

mitered, but other parts are assembled with butt joints. The finished grater is used as above. Protect the box with spar varnish or lacquer, rubbed down and waxed.

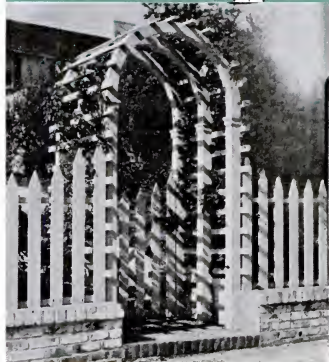
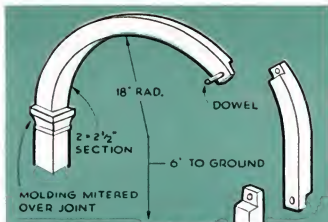


This filigreed latticework was jigsawed from $\frac{3}{8}$ " waterproof plywood. The drawing at left gives you the pattern on 1" squares.

Trellises Add Glamour at Low Cost

By Hi Sibley

NOTHING you can do with a hammer and saw will add more to a plain arch or entrance than latticework. Most of designs shown here can be straight hand-tool jobs. Even the filigreed trellis shown on this page was cut out by hand. If you have



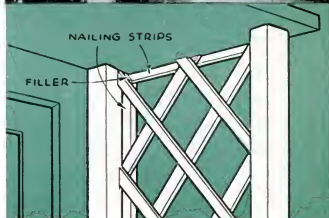
Arched gateway is a universal favorite. Bandsaw was used to cut out arch members. They are joined with dowels and waterproof glue.

a power jigsaw but find that the panel is too long to be handled conveniently with your equipment, you can cut it out in sections. Then assemble it in its location with glued and splined or doweled joints. In all such outdoor work, use a waterproof glue such as a resorcinol or urea type.

A simpler installation is shown at the top right of this page. Here the lattice is nailed to strips on the posts and porch roof. You'll find that one lattice strip at top and bottom needs a short filler piece between it and the nailing strip.

One of the most popular types of gateway is the arch pictured above. The arch members are bandsawed in three sections and joined with dowels and waterproof glue. Note that the horizontal strips project beyond the frame members both ways.

At right is an effective design for an archway of not less than 4' radius. The



Simpler design above is a hammer-and-saw job. Middle slat overlying others should be shimmed up at top left-hand corner.



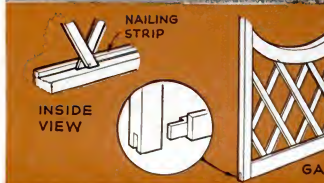
This style is adaptable to an arch with an opening large enough to permit bending the frame. Spruce was bent and screwed to wall.



Rim of this half-wheel pattern was scroll-sawed in three sections and joined with glue and dowels. Inner curved piece was nailed.



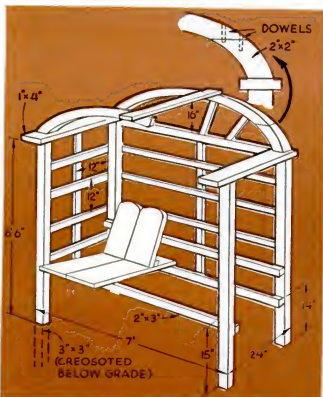
Attractive trellis arrangement alongside chimney breaks up the straight lines of the fence and provides support for climbing vines.



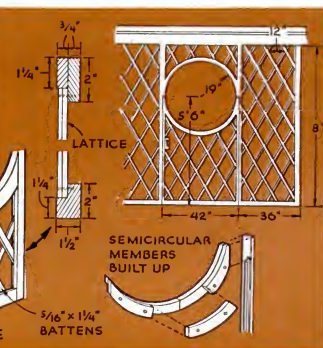
Open latticework encloses this long porch. Circular opening at the gate was built up of

curved pieces are spruce, soaked and bent and then fastened to the wall with masonry anchors. The slats were nailed on radially.

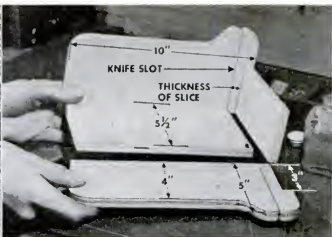
The half-wheel pattern at left has a rim scroll-sawed in three pieces. The inner ring was bent and nailed to the spokes. Hickory or spruce, soaked overnight or steamed, is suitable for this part of the design. END



Seat with trellis has bandsawed top beams built up with doweled lap joints. Note that posts are creosoted below grade as rot protection.



several pieces glued and doweled together. Careful sandpapering and filling conceals joints.



Bread Slicer Works like a Miter Box

UNIFORM slices of bread drop out a slot into a basket or pan when the end of this cutter is allowed to overhang the work surface. A sawing action with the knife cuts the slices evenly as fast as you can feed the loaf into the box.

The slicer was made from $\frac{1}{2}$ " plywood. For some home-style loaves it may be necessary to vary the dimensions slightly. In laying out the parts, note that the sidepieces

are notched to receive the 3" by $6\frac{1}{2}$ " end. The lowered sides make it easier to grasp the loaf and box.

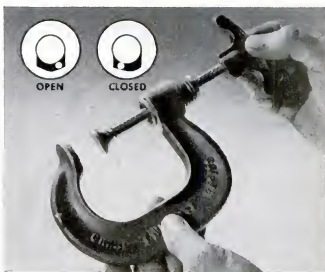
Continue the knife slots $\frac{1}{32}$ " below the top surface of the bottom so the knife will separate the slice cleanly. If the slots are cut with a power saw, widen the kerf with a second pass. Smooth the slots by drawing sandpaper through them. Varnish or lacquer the finished box.

Quick-Adjusting Clamp Jaw Locks with a Twist

WITH these C clamps, you don't have to waste time making adjustments. To suit the clamp to the work, you slide the pressure rod in or out. A clockwise twist of the handle then locks the rod to the threaded member, a roller jamming in an internal cam when the rod is turned in one direction.

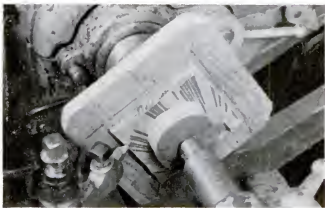
A further twist of the handle causes the foot to exert pressure on the work. A counterclockwise turn unlocks the bar and allows it to be withdrawn.

Richards' Industries, Inc., Grand Rapids, Mich., makes the clamp in 2" to 6" sizes. A ball bearing between the foot and rod end prevents torsion on the work.



Plastic Cemented for Turning

RUBBER cement provides an easy mounting method when you want to turn a plastic disk. Attach a piece of wood to the lathe faceplate or mount the wood on a screw center. Apply cement to the wood and to the masking paper on the plastic, let it dry, and then press the plastic and wood firmly together. Push a smaller block of wood against the plastic with the tail center.—Joseph F. Gréce, Bronx, N. Y.



Making Hopper Joints by Hand

By Edwin M. Love



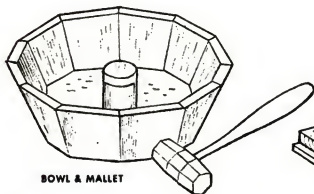
Though they look like straight-cut tapers, hopper joints can be tricky because compound angles deceive the eye.

TAPERED boards are those that are cut on a slant. In most cases that's all they are—which is fortunate for the amateur workshopper. Calculating angles and cutting them accurately with hand tools can sometimes be a tough job.

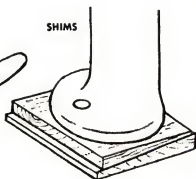
But when you are tapering table legs the exact angle makes precious little difference.

All that matters is that the mating pieces have the same taper—or appear to have it. The same is true for bench ends, door stops, and clamp wedges.

In this form tapers are easy, for even where precision is required, the measurements are usually given in lengths rather than angle of slope. All you have to do is



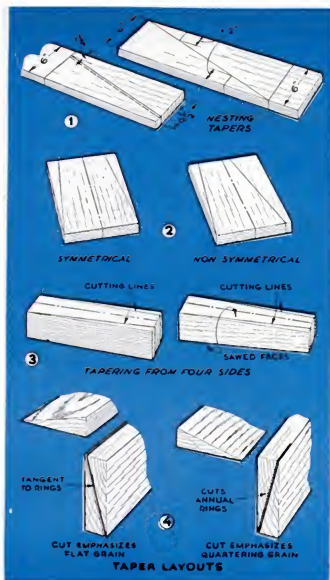
BOWL & Mallet



SHIMS



TABLE



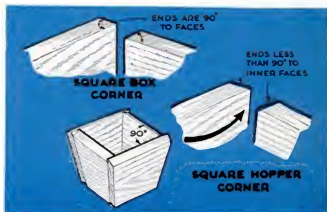
Saw tapers as you would any straight edge. Pencil center lines; cutting lines may be scored. When nesting tapers, allow for saw waste.

measure the given dimensions—say the width at top and bottom—and connect the lines with a straightedge.

Let's say you need a board of given length with one edge tapering from $4\frac{1}{2}$ " at one end to $1\frac{1}{2}$ " at the other. All you have to do is mark these dimensions and saw to the line, letting the angle fall where it may.

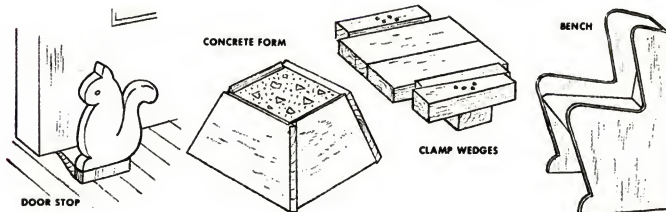


5. Rip short sections by holding the work in a vise. Saw half through; then cut from the other end. Support long pieces on sawhorses.



6. Ends are at right angles to the faces in square box. But to make hopper come out square ends must be at a less than 90° angle.

Often you'll need two such pieces, and you can save material by nesting them in a single board of sufficient width (Fig. 1). Remember that some stock is lost in sawing, so allow $\frac{1}{8}$ " or more between the pieces. If the board isn't wide enough to make two such pieces in the same length (as would be the case if the measurements were upped to



2" and 6") you can still save some stock by nesting them for part of the length. This is shown in the upper sketch of Fig. 1.

Bench ends and the like are often tapered about a vertical center line (Fig. 2), especially when hardwood chosen for its grain is used. To lay out such a piece, pencil a center line and measure to both sides. Incidentally, it's easier to erase a pencil line from wood than to sand it off.

To taper legs symmetrically from four sides, square the ends and draw the taper lines on opposite faces (Fig. 3). This will give you guide lines to follow and enable you to correct the saw by cutting alternately from one side and then the opposite. Begin ripping at the thick end of the waste where it is easy to start and there is enough support to establish the direction of the cut. As the waste strip gets thinner, hold it against the saw with the left hand. Smooth the sawed faces and draw cutting lines on them to guide you in sawing the remaining sides.

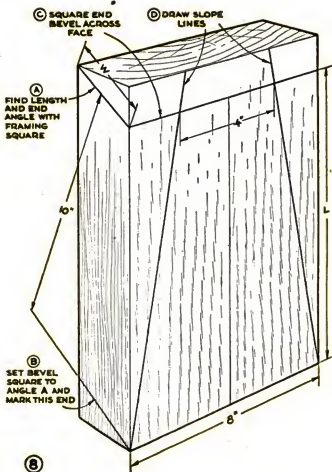
If the taper is slight, hold the work in a vise or against a bench stop and rough down with a jack plane. More taper can be negotiated with a draw knife. When a leg tapers only from two adjacent sides, half the work is called for but the layout is approximately the same as in Fig. 3. Draw the taper for one edge on opposite faces, and work to the line. Lay out the second taper on the finished side and the one opposite to it.

Section tapering, illustrated in Fig. 4, is accomplished by ripping a strip from opposite corners—or points near these corners. Give thought to the direction of the diagonal, for one way it emphasizes the flat grain while from the opposite corner it gives a quarter-sawn effect. Rip short pieces in a vise, as in Fig. 5.

Up to this point tapering is a cinch. But sloping sides appear also in that mathe-



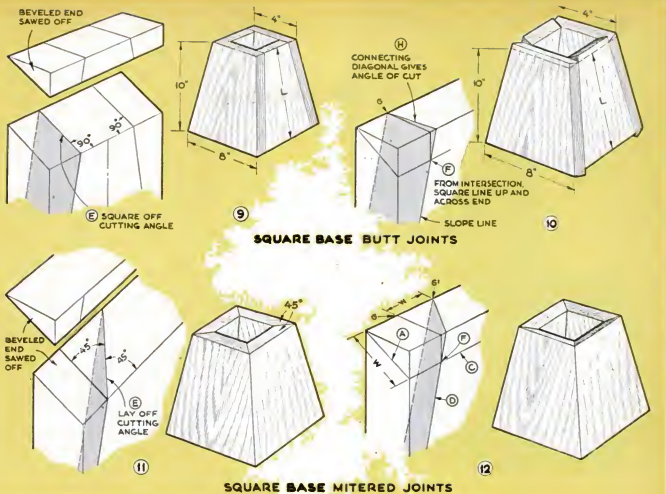
7. Measure column length on the blade of a square and slope on the tongue. A line drawn along the tongue gives the end angle.



These are the first steps for practically any kind of hopper side. Bevel A is obtained as in Fig. 7; for B, set a bevel square to A.

matical headache, the hopper. Sometimes you see this construction as a flared bowl or flower-pot holder, sometimes as a tapered column or a form for a concrete pier. The chief difficulty with hoppers is that their angles are never quite what they seem to be. In Fig. 6 the butted corners of a hopper are compared to those of a square-sided box. In the box the butting ends are square with the faces of the stock and also with the top and bottom edges. In the hopper the ends are square with the edges, but since these are beveled, neither end nor edge is square with the face.

To locate cutting lines for the sides of a hopper or tapered column it is necessary to proceed systematically. Some information is usually given in advance. Or, if you are drawing up your own designs, you will pick dimensions to fit your requirements. Let's say you need a column 10" high having a slope of 2". The height is measured along a plumb line dropped perpendicular to the base. Since the sides lean off the vertical,



The edge angle for square-base hoppers may be found by any of these methods. On a beveled end, mark the angle with square or pro-

tractor as in Figs. 9 and 11. To mark the cutting line on a square end, follow Figs. 10 and 12. The first four steps are same as in Fig. 8.

they will actually have to be more than 10" long. Knowing the height and slope, you can determine the length by using a framing square as in Fig. 7. Lay the square on the edge of the piece with these figures coinciding with an arris. A pencil drawn along the tongue marks the angle of the end. Set an adjustable bevel square on this angle and use it to mark the same angle at the opposite end. These are indicated as steps A and B in Fig. 8.

From the point where the end-bevel line meets the face of the stock, square a line across the face (step C, Fig. 8). Draw a center line and measure each way from it to determine the slope of the sides (step D, Fig. 8). The slope here is given as 2" in 10". That is, each edge slopes 2", making the hopper 4" narrower at the top than at the bottom. Since the joints are butted, these dimensions apply only to the overlapping members; the inner pair must be narrower by twice the width of the end bevel, W.

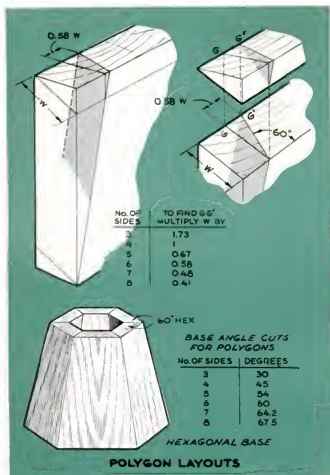
Getting back to the out-of-square joints

shown in Fig. 6, if you saw off the ends on the bevel line, all you have to do is square across the bevel to get the cutting angle. This is shown in Fig. 9. When the sides are put together, the beveled ends will be horizontal. Therefore cuts that are 90° to the bevels will square up.

This is a fairly easy solution, but it won't hold in all cases. There are times when it



13. Lay a straightedge from the end of the slope line to point G or G' and mark the cutting line. Use a sharp point or knife blade.



14. Layouts for polygons follow the same procedures as for squares except that the angle or distance G-G¹ varies with number of sides.

is better to lay out the cutting line on the square end before sawing the bevel. The process then becomes slightly more complex.

Repeat steps A to D of Fig. 8. You will notice that the lines called for in steps C and D intersect. From the intersection, square a line straight up and across the end, as in step F, Fig. 10. For convenience, let's call the place where this squared line terminates point G. Connecting G with the end of the slope line gives the cutting line (step H, Fig. 10). Though it's arrived at differently, the angle is precisely the same as that obtained in Fig. 9. Set the bevel square on this angle and use it for marking the remaining edge or edges.

If you are still in doubt as to why a cutting angle drawn on a square end differs from that drawn on a bevel, study Figs. 9 and 10. Whereas the line drawn on the bevel is square with the face, the diagonal, H, swings to the right because the slope line moves toward the center as it extends from the intersection, F, to the end of the stock.

Though there are many variations in hopper joints—miters, polygons, and the like—the two basic approaches to the problem of

finding the cutting angle are shown in Figs. 9 and 10. For other applications it is only necessary to extend these methods or substitute the appropriate angle. Thus, Fig. 11 shows how to mark the side of a four-sided, square-base hopper using miter joints. As is usual with miter-joined structures, all four sides are the same width. Find the end bevel as in Fig. 8 and cut off the waste. Draw a cutting line on the beveled end 45° to the face. The only difference between a mitered and a butted edge is that the angle is 45° instead of 90°.

To find the angle without beveling first, proceed as in Fig. 12. Steps A to D again follow Fig. 8. Step F, is the same as in Fig. 10. Now measure the length of the bevel line, W, and lay off an equal distance from point G. This measurement gives you G¹. Connect G¹ with the end of the slope line to get the cutting angle.

This is typical procedure for any polygon. Referring to Fig. 14, you can see that the layout of any hopper having from 3 to 8 sides is exactly the same as in Fig. 11 or 12 except for the base angle or the distance from G to G¹. If you cut the bevel first, mark the edge angle 30°, 54°, 60°, or whatever is required for the given number of sides. Note that the angle is measured from the face. Mark the desired angle with a protractor and extend the diagonal to the opposite aris (G¹).

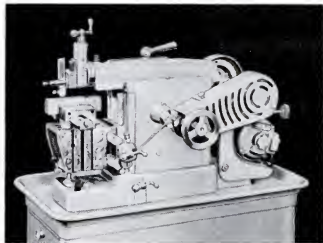
Laying out the angle on square-end stock exactly follows the procedure described for four-sided miters except that the length of the line G-G¹ is determined by multiplying the bevel length, W, by the factor given in the upper table of Fig. 14. In a six-sided polygon, for example, the multiplier is .58. Thus, if W measures 1½", the length G-G¹ will be 1.5" multiplied by .58 or .870". The distance to lay off would be ¾". It isn't exact (¾" would be .875") but it's as close as a saw and pencil will come in any case.

After sawing the edge you'll usually have to true it up with plane and sandpaper. You can correct for slight irregularities in this smoothing operation.

Hoppers can be assembled with plain or reinforced joints, using slip tongues or dowels. Clamping is a little more difficult than with straight columns, but if the taper is so steep that the clamps fall off, they can be restrained with wires fastened to nails inside the column. A square tapered column is easily clamped by driving over it two or three square frames built to fit. END

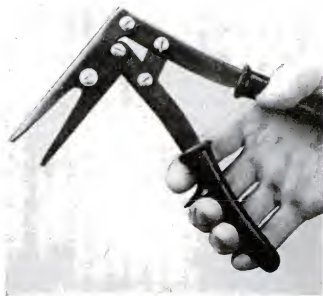


NEW TOOLS



New Precision Bench Shaper.

A 7" bench shaper is now being manufactured by the South Bend Lathe Works, South Bend, Ind. Table slides and the 18" ram are milled and hand-scraped for precision fit. Cutting speed is variable from 3' to 118' per minute. Stroke rates from 42 to 195 are available in four steps. The swiveling tool head has 3" feed. A $\frac{1}{2}$ -hp. motor drives the shaper.

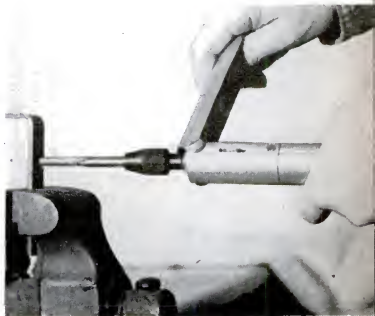


Pliers Turn Corners. Designed for work in tight and inaccessible places, these new pliers are quickly set to various angles to suit the job at hand. They are said to provide plenty of holding power at any angle. The jaws release automatically by spring action. Manufactured by Industrial Products Company, Philadelphia, the pliers are 10 $\frac{1}{2}$ " long, weigh 8 $\frac{1}{2}$ oz., and sell for about \$3.25.



Torch Burns Tank Gas.

A new series of torches introduced by Weldit, Inc., Detroit, is designed to use atmospheric air and propane or acetylene, carried in small portable tanks. Shown in use above is a light torch with needle-valve adjustment. In the inset is a larger type that has Weldimatic® trigger control. When released, this cuts the flame to a pilot light. Pressed, the trigger again gives the original work flame.

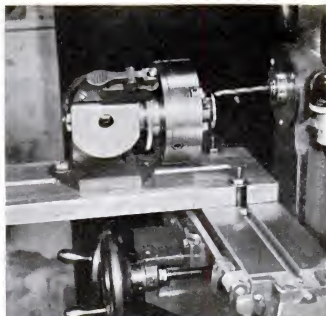
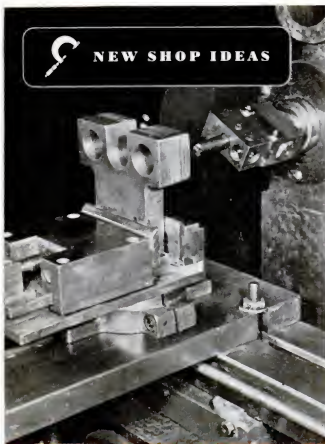


Tool Drives Screws and Taps.

A folding lever on the Tooldriver® gives leverage for driving big screws and taps. A ratchet mechanism makes the action similar to a brace and bit when the lever is out. With the lever folded down, the tool becomes a ratchet screwdriver. The chuck takes taps up to $\frac{1}{2}$ ". Westport Tool Co., Portland, Ore., prices it at \$3.75. Screwdriver bits of different size can be used.



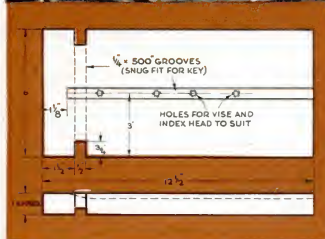
NEW SHOP IDEAS



Milling Capacity Increased. The short transverse travel of small milling machines limits their usefulness. An adapter plate overcomes this difficulty by allowing the vise or work to be mounted at a greater distance from the spindle. This permits the use of boring heads and standard-length drills and reamers.

The plate can be made from aluminum alloy, brass, or steel, but cast iron probably is best. The plate dimensioned in the drawing is for milling machines that use $\frac{1}{2}$ " square T-slot keys.

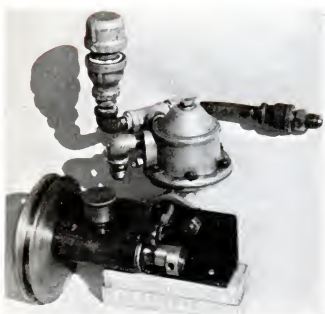
The plate opens up a big new field of possibilities. An index head usually is mounted with its axis perpendicular to the spindle, but with the plate you can mount it to face the spindle for such jobs as rotary milling or making simple drill jigs.—J. C. Magee, Schenectady, N. Y.

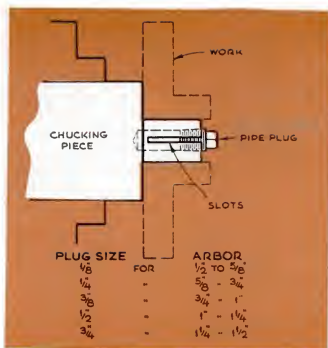


Fuel Pump Circulates Coolant.

A Ford fuel pump can be adapted for use as a small coolant or circulating pump. As set up in the accompanying photo, the pump lifts liquid about 24" and delivers about two quarts a minute at 700 r.p.m.

The socket that receives the push rod was removed and a pair of side arms, enclosing a brass roller, riveted on in its place. An eccentric installed on the end of the pulley shaft provides movement of $\frac{5}{32}$ ". A bearing was made by welding a piece of $\frac{3}{8}$ " pipe to the edge of a piece of $\frac{1}{2}$ " by $1\frac{1}{2}$ " by $1\frac{1}{2}$ " angle. The pipe was poured solid with babbitt metal and then bored on a lathe. The upright $\frac{3}{8}$ " fittings act as an air chamber and help deliver an even flow.—G. R. Enevoldsen, Lovell, Wyo.

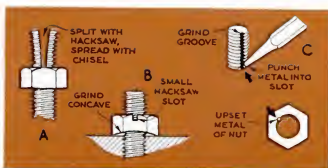




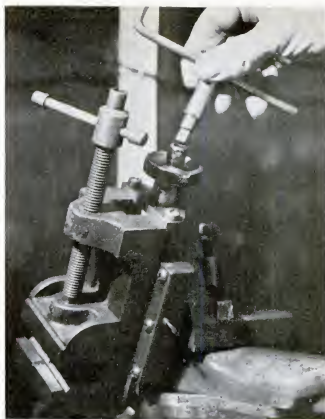
Stub Arbor Uses Pipe Plug.

There are several ways of mounting a piece of work to turn it down concentric with an existing hole. The method above holds the work tightly but doesn't mar the bore.

Rough-turn the stub to about $1/32$ " greater than the desired diameter. Then drill and tap it for a suitable tapered pipe plug and mill or hacksaw a slot $1/16$ " wide across it. Rechuck the arbor, screw the pipe plug lightly in place, finish-turn to exact size to fit the bore, and face the locating shoulder. Tightening the plug expands the arbor, holding the work securely for either turning or facing.



Locking Studs or Nuts. If lock washers aren't available or won't do for the job at hand, here are some other dodges. When a nut is used, you can resort to the solutions illustrated in A or B. To lock a stud in a metal block, grind a groove lengthwise, turn the stud into the block, and jam it by punching metal into the slot from the edge of the block, as in C. Alternatively, metal from a nut can also be upset to lock it on a stud.—George Burnley, Oakland, Calif.



Sockets Speed Adjustment. Two $\frac{1}{4}$ " wrench sockets pressed or brazed on the vertical feed knob and vise screw of the milling attachment above provide quick adjustments and a more even feed.

The $3/16$ " size hex or 12-point sockets are well suited to the job. Adjustments are made by inserting a chuck wrench into the square holes. In my case the wrench is fitted with a hooked pin to give crank action. When the feed slide is near the upper limit of its travel, the chuck wrench may foul the vise screw. Then, instead of the chuck wrench, I use a standard $\frac{1}{4}$ " speed wrench. —H. Landauer, Tampa, Fla.



Opposite Threads Make Knurl. Lathe owners who lack a knurling tool can accomplish the same result by first cutting right-hand threads and then left-hand threads on the knob or other metal part where knurling is desired. The finer the thread, the finer the knurl, but eight threads per inch give a good pull grip. Multiple threads provide a better twist grip.—Fred F. Davis, Edmonton, Alberta.



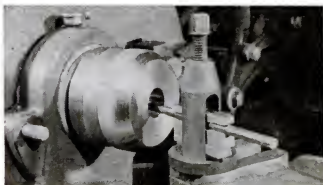
After the bar stock is faced on both ends, it is bored out and threaded to fit the headstock spindle. The threads should be cut carefully.



Medium diamond knurl is made with the collet chuck on the spindle. A transverse blind hole for a spanner goes in relieved center section.

end for $\frac{3}{8}$ " to suit the draw-in spindle—.645"-.26 for standard ones. At the middle of the piece, take 12° taper cuts down to the .650" diameter, forming the collet heads. Remove the work from between centers, chuck near the middle, and separate the two blanks with a parting tool. Put the collet nose on the spindle and use it to hold the collets, one at a time, as you face and chamfer them.

The collet holes to receive the work—a full set might range from $\frac{1}{2}$ " down to $\frac{1}{32}$ " in 32nds—should be made with care. Use a drill $\frac{1}{64}$ " under the desired finished

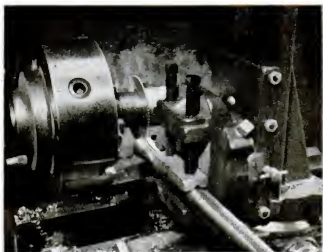


The taper in the collet chuck is made with the compound set over 12° . For best finish, use a newly honed round-nose tool and very fine feed.



Collets are turned in pairs, nose to nose. The blank is chucked to cut them apart. A finished

collet should never be used to hold stock that's more than .005" over or under its nominal size.

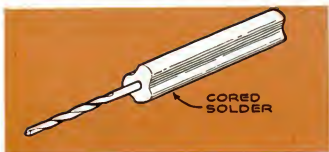


Setup for slotting. Here saw is reversed and lathe run backward to avoid inside burr. With work over saw, a conventional setup would do.

size and then a drill of the exact size. Chuck them in the tailstock and run in the drills to a depth of about $\frac{3}{4}$ ". When all collets have been drilled, put on the three-jaw and chuck each collet backward, with the threaded end toward the tailstock. Then feed in a $\frac{1}{2}$ " drill to the base of the head, leaving a collet bore about $\frac{3}{8}$ " long.

Use a milling attachment, if you have one, to make the three slots 120° apart. (Lacking it, you can devise some clamping arrangement on the carriage.) Use the draw-in spindle to protect the collet threads from the milling vise, and mount a .040" slitting saw. If you set up the cut under the saw, reverse the tooth direction and lathe rotation to avoid an inside burr. END

Small Drills Chucked with Cored Wire Solder

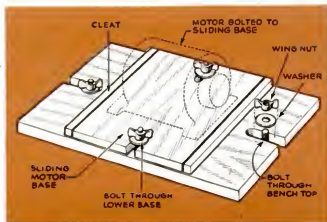


IF YOUR drill chuck won't close down on a very fine drill, cut a short length of rosin-core solder, roll it on a flat surface until it's straight, and force it on the drill shank. If necessary, ream the solder core out with the drill itself. The chuck jaws will form the ridges shown at left.—E. H. Godfrey, Highland Park, Ill.



Tiny Motor Has Reducing Gear

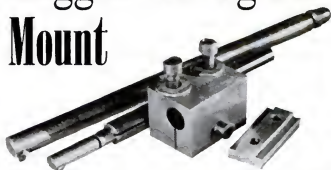
PROVIDED with a 12-to-1 reduction gear and a pulley, this British electric motor is designed for use in models and small control devices. The Mighty Midget® operates on a single flashlight cell, and its armature turns up to 10,000 r.p.m. on two cells. The permanent-magnet DC motor is reversible by a change of polarity. Distributed by Modelcraft, Ltd., London, it is made by Victory Industries, Guildford, England.



Motor Mount Set Two Ways

AMONG the advantages of this motor mount are easy adjustment of belt tension, easy speed changes by means of step pulleys, and easy transfer of the motor to operate separate power tools. Make as many of the lower bases as there are locations where you'll want to use the motor, and leave each such base permanently there. The upper base is permanently mounted to the motor, and the cleats on each of the lower bases are spaced to make a sliding fit for it. Plywood, $\frac{3}{8}$ " or $\frac{1}{2}$ " thick, is preferred material for both of the pieces.—W. Teeboon, Masterson, New Zealand.

Rugged Boring-Bar Mount



Both small and large boring bars fit this holder. Note split sleeve on small one above.

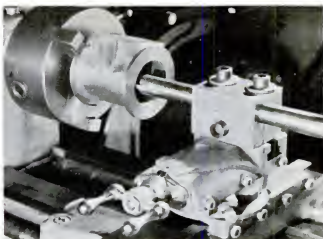
SO HUSKY it will handle the toughest boring jobs your lathe is capable of, this boring-bar mount merits a permanent place on your tool shelf. With the addition of simple split sleeves or bushings, it will hold bars of various sizes.

For the body, use a block of cold-rolled steel approximately the size shown in the drawings, which will fit a 9" or 10" lathe. Face the bottom in the four-jaw chuck, if you haven't a shaper. Then reclamp it with the trued face flush against one jaw as shown below, and drill and ream, or bore to size, the hole for the bar. In use this must lie at lathe center height. Spot the hole as far from the bottom face as the distance from the lathe center to the top of the compound rest on your lathe.

Drill two $\frac{3}{8}$ " holes through from top to bottom of the block for the clamping bolts. Then cut the slot up from the bottom to the boring-bar hole, using a hacksaw or, if you have a milling attachment, a slitting saw as shown at the right below.

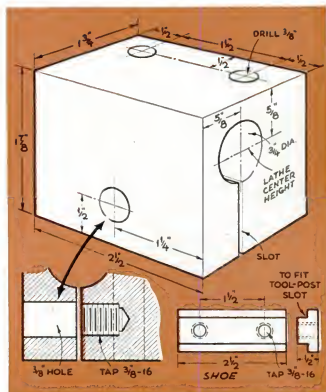
Drill the transverse hole for the bar clamp screw $\frac{3}{8}$ " past the slot with a 5/16" bit; then open it just to the slot with a $\frac{3}{8}$ " drill. Tap the smaller part $\frac{3}{8}$ "-16. Finally, chamfer all edges of the block and draw-file smooth all over.

Make the clamp shoe from a piece of $\frac{1}{2}$ "

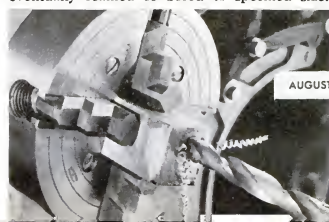


Straddling full width of compound rest, the holder gives sturdy support for heavy cuts.

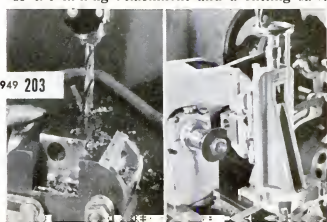
by 1" bar stock to fit the tool-post slot. The steps for the T shape can be hacksawed and filed, but are a simple milling job. The shoe can also be built up of two pieces. Space the $\frac{3}{8}$ "-16 holes to match the bolt holes in the block. With hollow-head cap screws and washers, the mount is ready for use.—C. W. Woodson, East Aurora, N. Y.



With trued face flat against one chuck jaw, the $\frac{3}{8}$ " hole is started with a smaller drill, eventually reamed or bored to specified size.



Mounting holes are drilled through from top face (left below). Slotting the block is a job for the milling attachment and a slitting saw.





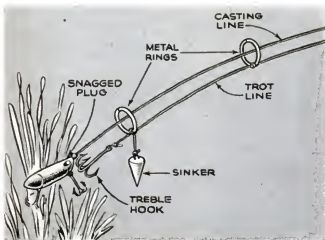
Kitchen Bar Built Around Old Phonograph

AN OLD phonograph cabinet forms the principal part of this kitchen combination. The built-on top serves as a snack bar while the drawers and cabinet provide storage space.

First, remove the cabinet trim and cut down the legs. (Save the lid; it can be used as a shadow-box picture frame.) Next take out the works and the turntable, as well as album partitions that may be in the lower section. Using $\frac{1}{2}$ " or $\frac{3}{8}$ " plywood, lay out the top to suit your needs. The apron between

the single leg and the phono cabinet provides all the bracing needed. The drawers beneath the top are from a fiberboard shoe wardrobe. Hooks for the pots are screwed into a strip of wood under the drawers.

Cover the top of the bar with imitation leather or sheet plastic—the kind used on table and counter tops in lunchrooms. Enamel the leg, cabinet, and apron to suit the color scheme of your kitchen. The addition of gliders and door handles completes the job.—Phil Swanson, Los Angeles.



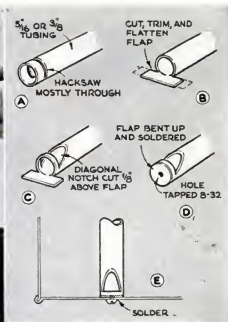
Rig Frees Snagged Plug

FOR retrieving fouled fishing plugs, I've found this rig to be the answer. On the end of a length of trotline, I fastened a large treble hook. An inch up from the hook, a metal snap ring—the kind used in notebooks—was knotted in the trotline. About 3' up a second ring was tied on. A large sinker was tied to the lower ring. I snap the rings around the casting line and slide the rig down the line. With a little manipulation the hook catches in the fouled plug.—C. H. King, Chattanooga.



Liquid Forms Dry Lubricant

APPLIED like paint, Neolube® dries quickly, leaving a corrosion-resisting coating of graphite. The maker, Huron Industries, Port Huron, Mich., says that, unlike oil, this compound will lubricate at both high and low temperatures and is electrically conductive. Among suggested uses are guns, sticking drawers and windows, locks and latches, model railroads, and piano mechanisms. Price is \$1 for 2 oz.



Completed outfit is shown at left. Working the hand pump forces air into the can. Air shoves fuel through hose to outboard's tank. Tubing may be screwed directly into brass globe valve,

center; brass cuts its own threads in copper tubing. Seal joints by soldering. Drawing at right shows how tubing is secured to bottom of can. Cover 8-32 screw with solder.

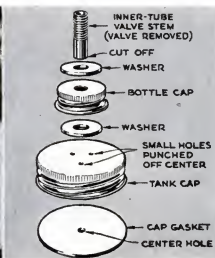
Pressure Tank Fuels Running Outboard

IF YOU'VE ever filled an outboard's tank in a choppy sea, you'll appreciate this pressurized can. Without stopping the motor or lifting the can, you can refuel. Working a hand pump builds up a small air pressure that forces fuel from the auxiliary tank through a Neoprene® hose to the motor.

Drill a hole in the top of a sturdy 5-gal. can to take a length of copper tubing. Saw and bend the lower end of the tubing as shown. Screw a small globe valve on the

other end. Thread a short piece of tubing in the other valve opening and force the hose over it. Fit the other end of the hose with a U-shaped copper tube to hang in the motor's tank when fueling. Locate the valve so the wheel and nipple are protected by the rim of the can. Keep the valve closed when the tank is not in use. For maximum safety, use no valve inside the inner-tube stem, so that pressure cannot be maintained.

—Clinton R. Hull, Costa Mesa, Calif.



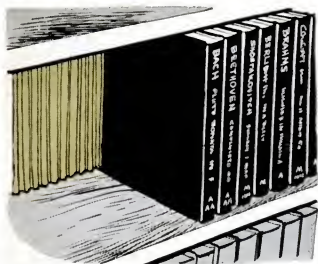
Where copper tubing protrudes through top of can, solder around it (left) to make tight seal. Center shows tank-cap assembly. Altered valve stem, with valve removed, is soldered in bottle

cap. This is soldered to tank cap, right. Small holes, punched off center, let air into tank through $\frac{1}{8}$ " hole in gasket but keep fuel from splashing out. Valve cap closes stem.

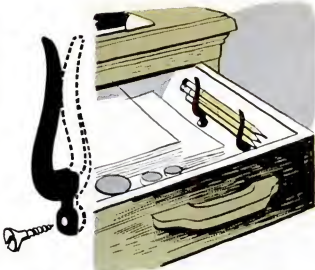
Keeping the Home Shipshape



A low-vision mirror makes a handy dressing aid. Use any wood-framed mirror of reasonable size. Mounted in a corner as shown, it takes up little space. Fit a wood shelf on top.



Record albums won't topple over when some are removed if you glue a sheet of corrugated cardboard inside the back of the cabinet. The cardboard ridges will keep the albums upright.



Pencils don't have to roll around in a desk drawer. Keep them in order by cutting down two plastic clothespins. Attach the one-prong pins to the drawer side with short wood screws.



Tweezers of any kind can be made from hacksaw blades. Grind the teeth off and shape the desired point. Heat and bend the tips. Bolt the ends together, spacing them with nuts.



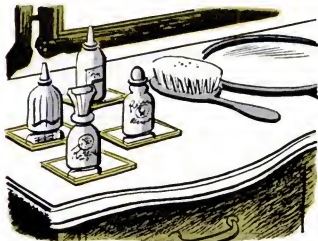
A safety lock for lawn mowers will discourage unauthorized borrowing and eliminate danger to children's fingers. One cutter blade is fastened to the crossbar by a bicycle lock.



A cherry pitter, bent from about 20" of coat-hanger wire, will be a help at canning time. The wire is shaped and used as shown. Hammer out the plunger end and file cross notches.



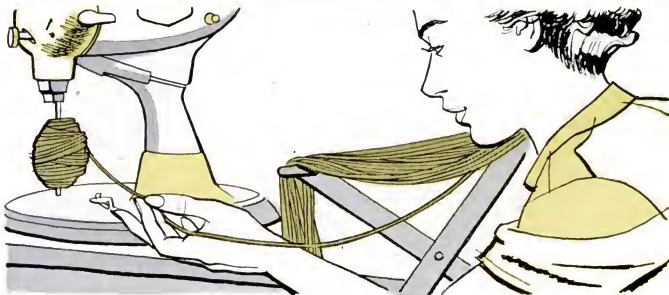
When you wash walls or woodwork, fold a washcloth and fasten it around your wrist with a rubber band. The folded cloth will keep water from running down your arm.



Purse mirrors make decorative coasters for the dressing table. Use them under polish, perfume, and similar bottles. They're easily cleaned and protect the table surface.



To cut corn from the cob, set one end of the ear into the center of an angel-food cake pan. It will hold the ear steady as you cut, and the kernels will be collected in the pan.



Tired of winding yarn by hand? Put your electric mixer to work. Remove the beater and

insert a small dowel. Running the mixer at lowest speed, guide the yarn lightly as it winds.

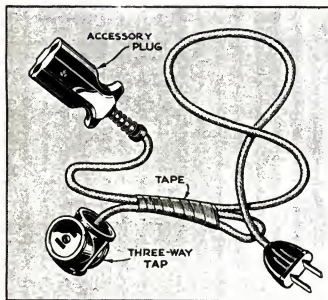


Camp Cooking with Metal Foil

AVAILABLE as a kitchen food wrapping and dish liner, aluminum foil simplifies outdoor cooking. With a roll of the foil in your pack, you can leave at home many of the usual camp utensils. Just wrap the food securely in the foil and place the package in a bed of medium hot coals until cooked. In experimenting with cooking times for various foods, the package may be opened, inspected, and replaced in the coals. We've cooked steak, fish, chops, hamburger, chicken, sliced potatoes, and even apple pie this way. Build the fire large enough so the bed of coals will remain hot for at least 30 minutes.—Paul F. Runge, Atlanta, Ga.

Cord Does Double Duty

A VERSATILE extension cord can be made from the cord used with some tank-type vacuum cleaners. Simply splice in a cube tap or socket by the end. The cord still can be used on the cleaner.—Henry E. Van Apel-doorn, Rochester, N. Y.



Old Churn Holds Wastepaper

THE unusual wastebasket pictured above is an old butter churn that I picked up in a secondhand store for 50 cents. I replaced the cracked lid and mended a split foot. Then the churn was sanded and given a coat of flat white followed by pale cream paint. I used a small brush to paint on the decorations. If you're not handy at designing decorations, find some to copy or use decals.—Roland Cueva, Heyburn, Id.

Gadget Dispenses Bread

TURNING the knob raises the loaf to bring to the top a slice at a time. When not in use, the lid is kept closed. The maker, Ward Philips Co., of Chicago, says the Bread Butler® keeps bread fresh for at least two weeks. It's priced at about \$3.



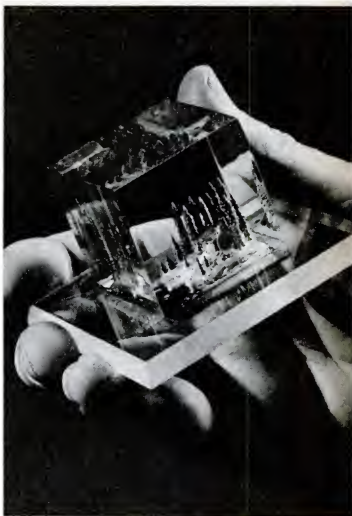
Carving Houses Inside Out

TURNING a hobby into a career, nice work if you can do it, put one PS reader right into business. It started when Karl J. Burg, of Clinton, Iowa, reached for some plastic scraps after reading an article on internal carving (PS, August, '47, p. 160). His skill made a quick hit with friends and co-workers.

Spare-time orders kept him so busy that in June, 1948, he started a full-time plastics specialty business. He now makes carvings ranging from tiny flowers in jewelry to public buildings in good-sized blocks, besides doing more conventional sign and display work. The architectural models are made to scale from photos or blueprints of actual buildings and bring from \$20 to \$200.

The photos below show a ranch-style house of Burg's own design, which he hopes to build as his home. The plastic block is about 3½" by 4" by 6". In such work, a vertical milling machine is used to form the main cavity, corners being squared up with tiny chisels and scrapers made to suit the job. Breezeways and overhanging roofs must be done largely by chip chiseling. All parts are dyed in natural colors.

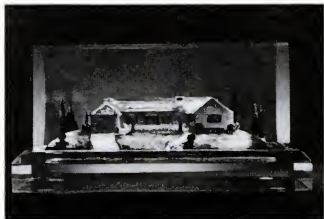
Burg's workshop includes a circular saw, jigsaw, small lathe, and other tools he has made himself. In spare time he still makes models as a hobby.



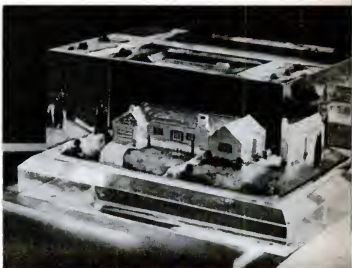
Cabin in the pines desk piece displays trees, a lake shore, boat at dock, a path, and cabin with a stone chimney. The carving sells for \$5.

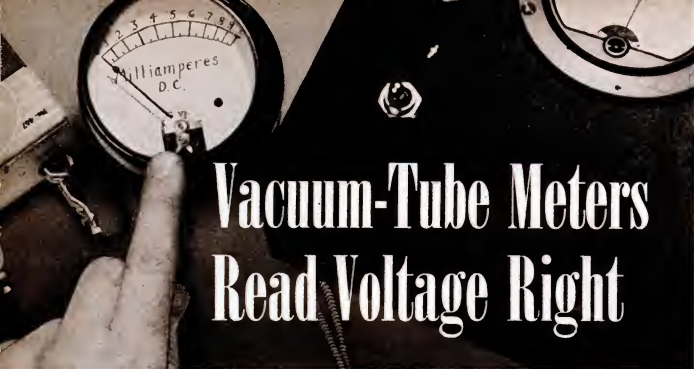


Ranch-style home shown below is turned up at right to reveal bottom cavity, made with both burrs and chisels. Carved parts are dyed.



Three-dimensional carving lets you see house from ground level, moderate height, or bird's-eye view at will. A model this big is \$80.





Vacuum-Tube Meters Read Voltage Right

Does a VTVM draw current from the circuit under test? The milliammeter gives the answer.

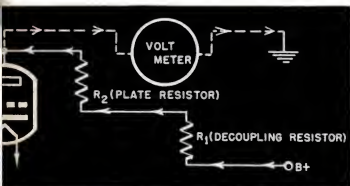
IF YOU'VE ever tried servicing a radio, you don't have to be told that a voltmeter is like an extra right arm. It's the tool that often tells you what the trouble is, and when it can't do that, tells you where to look for it.

Voltmeters can be roughly divided into three classes. Low-resistance meters are the commonest. They are usually rated for sensitivity in the neighborhood of 1,000-ohms-per-volt and require 1 ma. of current to deflect the pointer full scale. High-resistance meters of the 20,000-ohms-per-volt class are distinctly better and will give accurate results under most conditions. They need only .05 ma. to drive the needle across the dial. The third type is the vacuum-tube voltmeter, or VTVM. It has almost infinite resistance and takes practically no current for its operation. If you bear in mind that any current required by the meter must be

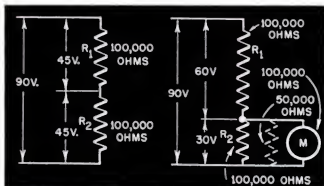
taken from the circuit being tested—which tends to "load" the circuit—you can see why it is often important to keep drain to a minimum.

None of this should be read as a criticism of the first two types of meter. Both have numerous applications if you understand their limits. But take the situation diagrammed in Fig. 1. The tube is receiving its plate current through R_1 and R_2 . Now if you try to measure the voltage at the plate with a 1,000-ohms-per-volt meter, you introduce another current-drawing element into the circuit, the meter itself. The extra drain may be very little (say a half or quarter milli-ampere); but since it must also flow through R_1 and R_2 , it introduces an extra voltage drop. Thus the very presence of the meter changes the circuit you are trying to measure.

Another way of viewing the same problem



1. Here's where the current goes. The meter "loads" the circuit by drawing extra current.



2. There should be 45 volts across R_2 , but an ordinary meter will give a reading of only 30.

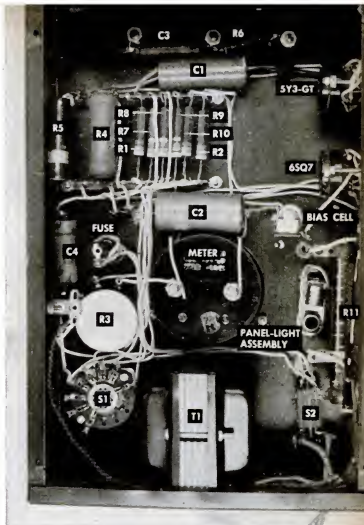
is illustrated in Fig. 2. The left-hand sketch shows a 90-volt source across which two identical resistors have been connected in series. Basic electrical theory tells you that the voltage will divide equally across the resistors. Now connect a low-resistance meter across R2. A 1,000-ohms-per-volt meter used on the 100-volt scale would have a resistance of 100,000 ohms. This gives you the effective circuit shown in the right-hand sketch. The net resistance of the meter and R2 is only 50,000 ohms. Voltage drop across this part of the circuit, therefore, is no longer 45 volts but 30.

The more we increase the resistance of the meter and the less current is needed to drive it, the more accurate will the reading become. That's a job for vacuum tubes. Tubes are able to amplify because a small change in current at the grid produces a much larger change at the plate. Thus if you feed an unknown voltage to the grid and place a reasonably accurate milliammeter in the plate circuit, you can obtain a meter in which the minutest amount of current will be sufficient to operate the meter movement.

The photos and drawings on the following pages show two vacuum-tube voltmeters. The larger one, diagramed in Fig. 6, was built by Tracy Diers, of Richmond Hill, N. Y. The smaller one (Fig. 14) made by Albert Rowley, Manhattan, N. Y., is a less versatile unit but easier to build.

Mr. Diers' unit will measure both alternating and direct voltages and has four ranges from 0 to 1, 10, 100, and 500 volts. A 6SQ7 was selected for the meter tube because in addition to the triode it contains diodes for rectifying AC. The grid of the triode is given a fixed bias of $1\frac{1}{4}$ volts by a bias cell of the type used in some amplifiers.

For the meter itself you may use any surplus or standard unit provided it has a basic movement of 0-1 ma.—that is, 1 milli-



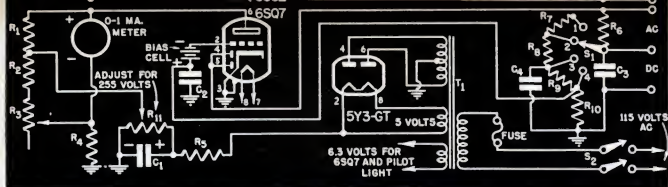
3. A combined chassis and cabinet is used for assembling the parts. Layout isn't very critical.



5. Range switch, test-prod jacks, and zero adjustment must be located on top of the panel.



4. If a meter is altered to read 0-1 ma. by removing a shunt, the scale must be re-marked.



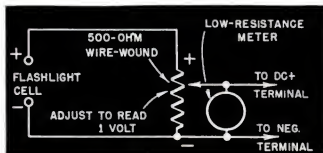
6. Parts used in building the VTVM must be of close tolerance, but the wiring is simple.

LIST OF PARTS

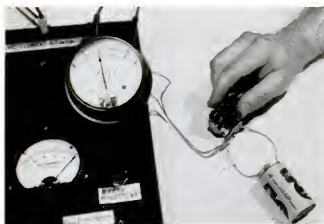
R1: 10,000-ohm, 1-watt carbon.
 R2: 1,500-ohm, 2-watt carbon.
 R3: 2,000-ohm wire-wound potentiometer.
 R4: 40,000-ohm, 20-watt adjustable wire-wound. Set slide for 36,000 ohms. See text.
 R5: 2,500-ohm, 5-watt wire-wound.
 R6: 1-meg., 1-watt carbon.

R7: 40-meg., 1-watt carbon (2% tolerance).
 R8: 9-meg., 1-watt carbon (2% tolerance).
 R9: 900,000-ohm, 1-watt carbon (2% tolerance).
 R10: 100,000-ohm, 1-watt carbon.
 R11: 15,000-ohm, 50-watt, adjustable wire-wound.
 C1: 8-mfd., 450-volt electrolytic.

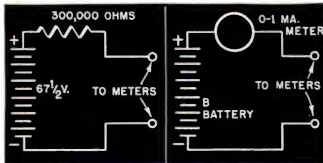
C2: .5-mfd., 450-volt paper.
 C3: .05-mfd., 600-volt paper.
 C4: .1-mfd., 600-volt paper.
 S1: 4-contact rotary switch.
 S2: DPST toggle.
 T1: 600 to 650-volt power trans.
 Meter (0-1 ma. DC), 1½-volt bias cell and holder, panel-light assembly, tubes and sockets, misc. hardware.



7. Calibrate the meter with this setup. Leave the low-resistance meter connected throughout.



8. The VTVM should give the same reading as the calibration meter. Zero the VTVM first.



9. In each of these circuits try first a low-resistance meter and a VTVM; compare results.

ampere causes full-scale deflection. It may be necessary to remove shunts or multipliers that are used to give the meter a different scale. If you do, re-mark the dial as in Fig. 4. Figures 3, 5, and 6 show the location of the parts and the method of connection. Scrape every contact and tin those that need it before soldering. This is important if you want clean, firm joints.

The unit is built into a chassis measuring 3" by 10" by 12". Tube sockets are mounted along an inner chassis edge by means of bolts and spacers. Some of the resistors called for may be hard to come by. If you have trouble finding any, remember you can always make up the right resistance by adding two or more smaller units in series. A higher wattage than specified will do no harm.

To obtain the proper operating voltage, a power transformer, T1, and a 5Y3 rectifier are used. The sliding arm on R11 has to be adjusted to 255 volts from slide to ground.

Scale selection is accomplished by means of a single-pole four-position rotary switch. With the slider on contact 1, the meter reads from 0 to 500 volts full scale (which means that you multiply the meter scale by 500). Contact 2 gives the 0-to-100 range (multiply by 100). Contacts 3 and 4 are for the 10- and 1-volt scales.

The meter is calibrated for DC. Note, however, that a separate terminal is provided for measuring alternating voltages. These are rectified in the diode portion of the 6SQ7. The meter registers *peak* voltage. Alternating current or voltage changes its value every instant, ranging from zero to

peak. The thing you usually want to know about it is the *effective value*, which is known also as *root mean square*, or *r.m.s.* To convert the voltage indicated on the meter dial to r.m.s., multiply the peak value by .707. In most cases multiplying by .7 gives a sufficiently close answer.

When you have completed the wiring, check the VTVM for accuracy of calibration. Turn it on and allow it to warm up. The meter needle will swing off scale, and then gradually fall toward zero. Insert one test lead in the common terminal and another in the DC jack. After about five minutes, short the prods by touching them together. Adjust R3 until you obtain a zero reading. These adjustments should be made with the selector switch on the 1-volt scale. When the prods are not touching the needle may swing away from zero, but the important thing is to have the pointer at zero when the prods are shorted.

If the meter fails to zero properly, you may have to readjust R4 slightly. The initial value of this resistor was figured as 36,000 ohms, but it may be necessary to raise or lower it a little by shifting the sliding contact. A 40,000-ohm adjustable resistor is suggested for R4. Note however, that it is shown in the diagram as a fixed resistor because once the proper value is found no further adjustment should be needed.

Hook up a flashlight cell and a 500-ohm potentiometer as shown in Fig. 7. An ordinary but accurate voltmeter may be used for the calibration. Vary the resistor until the meter reads exactly 1 volt. Connect the terminals of the VTVM to the points shown. The meter should read 1 milliampere—or, if you have re-marked the scale—1 volt.

If R7, R8, and R9 are known to be within 2-percent tolerance, it should not be necessary to calibrate for the higher ranges. However you may do so by adapting the setup of Fig. 7, using a higher voltage source, a 1-meg. potentiometer, and a multi-range voltmeter. Check full- and half-scale deflection on each range.

To demonstrate the superiority of a VTVM over ordinary meters, duplicate the circuit shown at the left in Fig. 9. With a low-resistance meter the probable reading will be about 25 volts; the VTVM will indicate very close to 67½ volts.

As a second step, check the current needed by each of the meters by inserting a 0-1 ma. meter in place of the 300,000-ohm resistor. Make a voltage reading across the



10. This simplified VTVM uses one tube. Scale divisions, from 0 to 25, are marked on glass.

terminals with a low-resistance meter and the VTVM. The milliammeter in series shows how much current is taken by each of the voltmeters. It will probably be something like .6 ma. for the low-resistance unit. How much does the VTVM draw? You can read the answer yourself at the top of page 210.

Compact One-Tuber

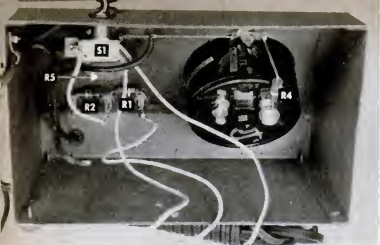
Everything that has been said about vacuum-tube voltmeters applies equally to the simplified model shown above and on the following page. Mr. Rowley's meter uses one tube and reads DC voltages only. It has three ranges, from 0 to 2.5, 25, and 250 volts. Selector switch and bias cell have been omitted, and one half of the 7N7 dual triode is used as a power rectifier by tying the grid and plate together.

Again, any good 0-1 ma. meter may be used; one with a fairly large scale is desirable since this hookup causes the meter to zero at midscale. A small meter would make the divisions hard to read.

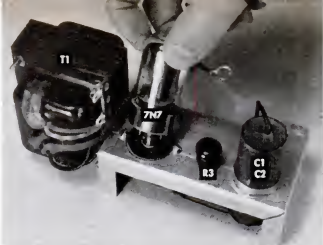
The power transformer has a high-voltage secondary of 240 volts on either side of the centertap. One of the outer leads is cut off and taped, as are both leads of the 5-volt secondary, which is not used.

Tube, calibration control, and most of the small parts are mounted on a 2½" by 4½" aluminum chassis. This unit, in turn, is installed in a larger cabinet on which are placed the meter, zero control, selector terminals, and switch.

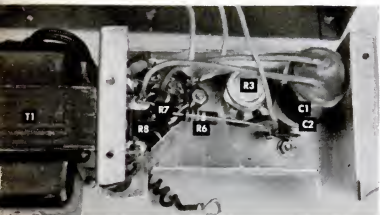
Like the other meter, this one has to be calibrated before it can be used. After completing the wiring, turn on the switch and let the tube warm up. After a few seconds



11. A few of the parts are attached directly to the front and top of a small metal cabinet.



12. The transformer is bolted to the chassis. Calibration control and the tube go on top.



13. Remaining parts are wired underneath the chassis, which is then placed in the cabinet.

the needle will start climbing to the center of the scale. Use the zero control to bring the needle to exact center. Repeat the setup shown in Fig. 7. Plug a positive test lead into the 2.5-volt jack and connect the leads to

take a reading. Adjust the calibration control so that the needle swings exactly one division when the low-resistance meter shows 1 volt. Reverse the polarity of the test prods and check the swing in the opposite direction.

Should the reading be inaccurate, readjust the zero control until the swing is exactly one division either way. Disconnect the test prods and make a sharp mark on the glass dial face at the point where the needle rests. Re-mark—on the glass—this new zero position and use it whenever you are testing on the 2.5-volt scale. Use the normal zero—i.e., dead center—on the 25 and 250-volt ranges. The meter reads both ways from center, so you don't have to worry about polarizing the test prods. This is handy in checking bias voltages where you'd usually have to reverse the prods.

END

LIST OF PARTS

All fixed resistors 1-watt carbon.

R1: 10 meg.

R2: 820,000 ohms.

R3: 250,000-ohm potentiometer.

R4: 2,700 ohms.

R5: 25,000-ohm potentiometer.

R6: 68,000 ohms.

R7: 1,000 ohms.

R8: 2,200 ohms.

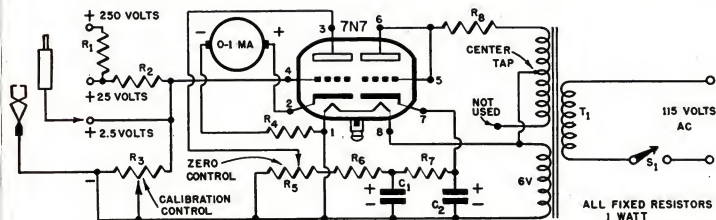
C1, C2: 6-8-mfd., 450-volt dual

electrolytic.

S1: SPST toggle.

T1: 480-volt power transformer.

Meter (0-1 ma. DC), 7N7 tube and lock-in socket, test prods.



14. Half of the dual triode serves as a power rectifier, the other half as the meter tube.

California amateur sends voice and picture over transmitter made from \$500 worth of war-surplus parts.

By Andrew R. Boone

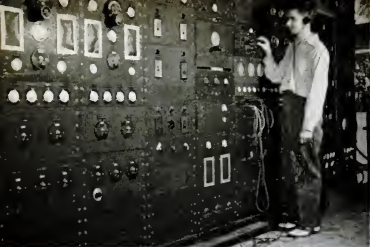
PULSING through the California skies from a weather-beaten back-yard shack, the image of a beautiful brunette flows into television receivers around San Francisco Bay. The boys who have seen her call the vision Gwendolyn.

Reproduced by a collection of second-hand tubes and war-surplus video equipment, Gwendolyn represents the first standard TV image broadcast successfully and repeatedly by an amateur. Soon, from the same station, W6JDI-TV, radio ham Clarence Wolfe, Jr. hopes to televise live images.

For over a year the 35-year-old amateur has been broadcasting Gwendolyn's picture from Burlingame, Calif., to demonstrate that

Gwendolyn, a picture of a beautiful brunette, is Clarence Wolfe's TV trade-mark. It's the only image he can now send over his homemade transmitter. Later he hopes to send live images and movies. At right, W6JDI's three rotating antennas.





Control panels for radio and TV fill one room of radio shack in Wolfe's back yard. Most of his equipment was built from scratch.



Real laboratory of W6JDI-TV is this board. On it each circuit was set up and tested. The best were later incorporated in the TV system.

his homemade \$500 TV outfit can compete with commercial stations. His R.M.A. signal—meaning a standard TV image that meets rigid standards laid down by the Radio Manufacturers Association—was flying into the winds six months before the first commercial telecaster went on the air in nearby San Francisco.

Not many have seen Gwendolyn yet. She is an image of 525 interlaced lines per picture and 30 pictures a second. The thing that keeps her audience down to a select few is that she travels around in the 429-mc. band, reserved by the Federal Communications Commission for amateur experimental work. Standard home receivers, tuned for the commercial bands between 50 and 200 mc., must use converters to receive ham TV. To hams that's only a minor problem. There

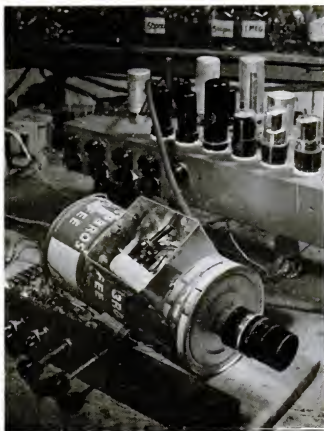
are a number of war-surplus radio altimeters that will step down the frequency properly.

Gwendolyn is the chief store-bought item in Wolfe's setup. She is a photograph of an unknown girl pasted inside a monoscope—a tube built to send a single image. Unlike the iconoscope or camera tube which scans any picture or scene, a monoscope sees only the photo bottled within it.

Two years were spent building the transmitter, but before that Wolfe spent 22 years building the experience that went into it. He became a radio bug in 1925 when he was 11 years old. In the following years he started a one-man radio service and repair shop in his home town, won his ham license (1932), and began seriously to study radio. Soon after he built the Burlingame police department's first two-way radio system.

From 14 tubes and a wartime chassis, Wolfe built this 50-watt, crystal-controlled transmitter. It is the final link to the antenna.

Experimental camera for live broadcasts and movies consists of an iconoscope or picture tube, three coffee cans, and a lens.



During the war he taught radio and radar, and later installed delicate fire-control apparatus. On returning to his store after the war he started learning the ways of television, and decided to become the first ham on the air with a standard TV picture. Unable to buy expensive commercial equipment, he set about building and adapting what he had or what he could get cheaply. For help he turned to a ham friend, Leslie Seabold, an airline radio engineer.

No well-equipped laboratory awaited his experiments. He had a few pieces of test equipment and a shop-full of odd and spare parts. To make a test panel, he screwed a few sockets to a board. With Seabold, Wolfe worked out the circuits on paper. Then he tried them out in practice. Literally hundreds were tested; only the efficient survived, and these were incorporated in the final sending apparatus.

He tackled the timer first. Twenty modifications came and went before he was satisfied with the neat unit that does the job today. After that came the control assembly, an intricate array of 120 tubes.

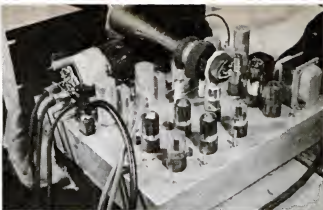
To get Gwendolyn's picture out with a big push, Wolfe settled on the antenna array shown in these pages—64 short lengths of aluminum tubing 1" in diameter. Half carry power, the other half serve as reflectors. In the favored direction, field strength is equivalent to 5,000 watts from a dipole. What's surprising about this figure is that the signal comes from the transmitter with only 50 watts of muscle behind it.

When field tests showed that he had what he wanted, Wolfe started his transmitter humming. "This is W6JDI-TV, broadcasting image of a girl on 429 mc.," he said into the microphone suspended above his battered desk. "Do you see her?" For several months he received no response. Except for the hams who picked up the pictureless voice, no one knew an amateur was putting out a TV picture. Then a few, eager to share in the adventure, hooked up radio altimeters to their television receivers. Six months after Wolfe went on the air, Bob Melvin, of Berkeley, answered: "Gwendolyn coming in clear and beautiful."

The name stuck. Confirmations came from Oakland, Vallejo, San Francisco, San Jose.

Incidentally, Melvin caught the bug shortly afterward and built a transmitter of his own in the family garage.

Wolfe now is trying to perfect a camera to replace his single-image monoscope. His



Lovely Gwendolyn reposes in lightproof tube made from candy container. On top is a monitor scope; in the foreground is the timing unit.



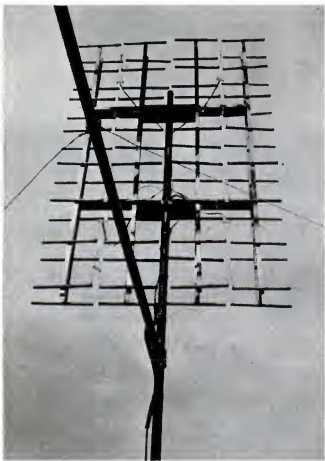
Control assembly started as a single oscillator. It develops three sets of synchronized signals that form the composite signal or picture.

Voice accompanies the picture. This is the control console of W6JDI-TV; it serves also for regular transmissions on other ham bands.





Experimental monitor tube in this portable viewer permits Wolfe to see from anywhere in his shop the quality of the outgoing signal.



Broad-band TV antenna consists of 64 elements; half are driven, the rest reflectors. Antenna covers a band 4.5 mc. wide.

Radio altimeter is used to convert a standard receiver to pick up the 429-mc. experimental band on which the broadcasts go out.



fifth model is a simple device—three 1-lb. coffee cans enclosing an iconoscope that receives images through a 2" f/1.5 lens taken from an old 16-mm. movie camera. With it he hopes to transmit live images and also motion pictures. But broadcasting movies will require a projector. That's in the works, too. From a standard projector he plans to remove the intermittent mechanism and run the film through continuously. By pulsing a light source 30 times a second and projecting the illuminated images onto the iconoscope he will change the frame speed from the 24 per second used in films to the 30 needed in video.

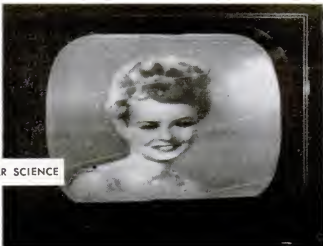
Movies present a special problem for the ham televiewer since one of the FCC rules governing ham operation is a restriction on broadcasting entertainment. Wolfe thinks that a good deal of the movie fare used on commercial TV stations runs no risk of entertaining anybody, but a legal definition of what a ham can televise is still to come.

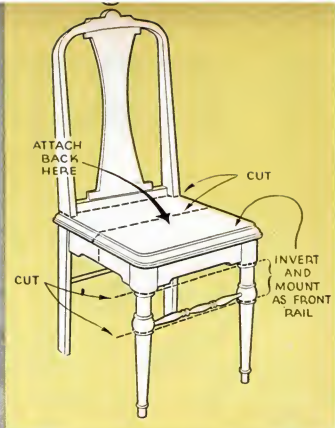
What does the future hold for amateur TV? Wolfe doesn't expect many hams to follow his lead, at least for the present. Cost won't be the big factor. The \$500 that this rig cost is a lot less than many hams put into voice equipment, but a lot of know-how and work is needed too.

Then, too, there are a lot of technical limitations that have to be overcome before TV can be reshaped into the ham tradition. First step will be simplification of the circuits and some method of getting more stations into the limited space in the airwaves. Perhaps ham ingenuity will also conquer the distance barrier that now makes television a short-range affair.

These are questions for the future. Radio once posed similar problems, and hams played a big part in solving them. Will they do the same for television? Wolfe has proved that video has a place for hams. He's given the wheel the first spin, and you never know where it will stop. END

This standard image of Gwendolyn has been picked up at points 35 miles away. She's proof that \$500 and ingenuity can put TV on the air.





Parts of Chair Shuffled to Create Wall Shelf

MAKING something new out of something old often gives as much pleasure as starting from scratch. This hanging novelty shelf was an example.

The front legs of a side chair were cut off just below the apron. A section including the rung also was cut from each front leg. Inverted, this assembly serves as a rail at the front of the shelf.

As the drawing shows, the seat was cut crosswise and the front section used as the shelf. The chair back and rear leg stumps were fitted to this.

After chips, cracks, and dents had been filled in, the entire job was sanded down to a fine surface. A priming coat, then enamel, and application of decals wound up the job.—*Simon S. Palestrant, Bronx, N. Y.*



Cabinet Fronts Now Available

IF YOU want to build cabinets in the kitchen, bathroom, or shop, these steel fronts introduced by Western Metalcraft, Inc., Olympia, Wash., may make your job easier. They consist of a metal frame and door or drawers—depending on the type of cabinet desired. The fronts are designed for use with simple plywood framing.

Suction Holds Handle on Glass

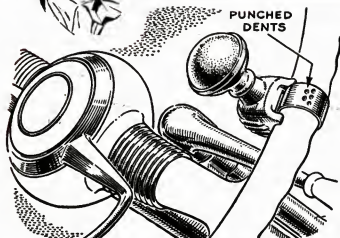
A SLIDING glass panel that partitions off the nursery in a local church had no handle. It could be opened or closed only by pressing a palm firmly against the glass. As a result, the glass always showed fingermarks.

The problem was solved by attaching a couple of suction cups to a plastic drawer handle, wetting the cups, and sticking them to the glass. The screws in the suction cups were the same size as those for which the handle was threaded, making it a simple matter to install the cups.—*Arthur Trauffer, Council Bluffs, Iowa.*





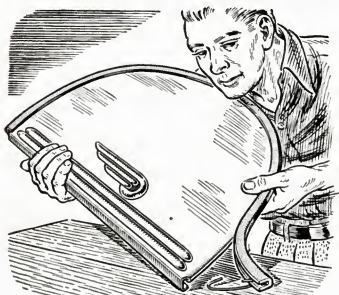
Hints from the Model Garage



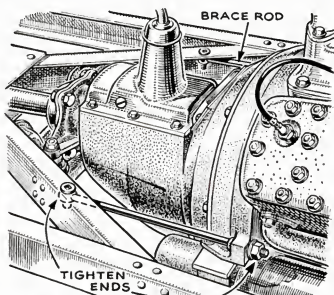
Steering Knob Kept Rigid. A spinner knob that twists in or out on the steering wheel can be cured by putting a few punch dots in the clamp. To avoid the possibility of cracking a plastic wheel, it's best to remove the spinner and clamp it on a broom handle or similar object. With a prick punch, make four or five dimples on opposite sides of the strap. When clamped, the spinner will remain in position permanently.—*Jim Sisley, Seattle, Wash.*



Light Does Double Duty. An accessory back-up light—the kind controlled by a separate switch—can be put to extra use as a direction indicator. Using red paint, I painted on the lens a big arrow pointing to the left. Now, when I'm making a left turn or pulling away from the curb, I flick the light on and off a few times. I've used the light for some time now and find it does its new job very nicely. It still gives ample light for backing.—*Ray Smiley, Detroit, Mich.*

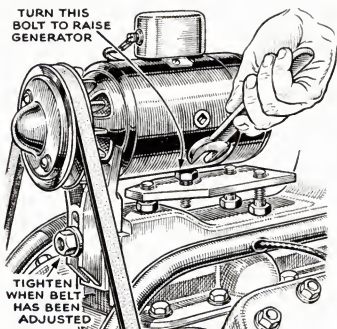


Replacing a Skirt Gasket. You can use a wide washing-machine cover gasket to replace a worn one on the fender skirts of some cars. Cut the rubber to length and stretch it around. Run a small wire hook through the inner side of each end. Fasten the hooks to the projections on the back of the skirt to hold the gasket.

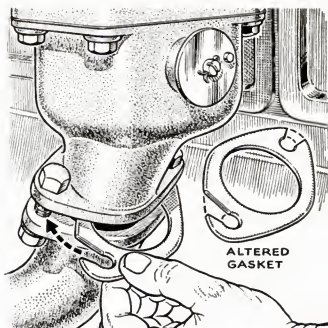


Keep Support Rods Tight. On prewar Ford V-8s, the two support rods that help anchor the engine at the rear have sometimes led to a false diagnosis of clutch trouble. If the rods loosen up, the result is similar to clutch chatter. The remedy is simple: either tighten the rods or replace them.—*A. Zanelli, Clifton, N. J.*

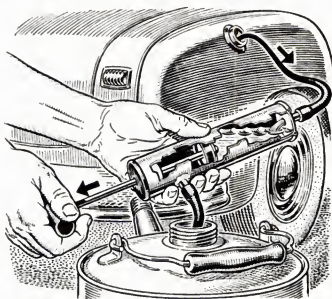
TURN THIS
BOLT TO RAISE
GENERATOR



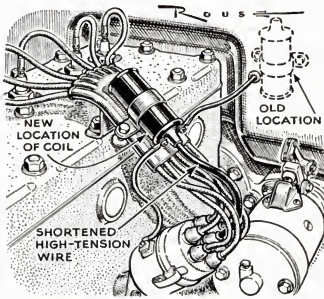
Tool Supports Generator. On some cars it's very tough to hold the loosened generator up in position while adjusting belt tension. The tool illustrated takes care of this. It consists of a piece of $\frac{1}{2}$ " steel plate tapped for four $\frac{1}{2}$ " bolts. Turning the one at the center with a wrench gives a powerful upward thrust, holding the generator at the desired level until the belt-adjustment nut can be tightened. Adjust the length of the leg bolts as required.



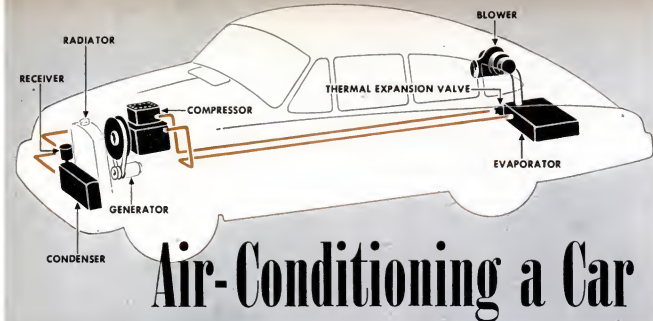
Gasket Slots Ease the Job. Narrow slots cut from the edge of a gasket to the bolt holes allow you to install a new one without taking out the bolts. This may be specially helpful on exhaust manifolds or other parts where bolthead clearance is scant, or where threads are so rusty that complete removal would be a time-consuming job. Just loosen the bolts enough to separate the flanges. The slots do not impair the efficiency of the gasket.



Spray Gun Siphons Gas. A siphon for drawing gas from a tank can be made out of an insect spray gun. Take out the plunger and reverse the cup leather. Cut off the spray container, enlarge the hole in the end of the cylinder, and solder in a piece of $\frac{1}{4}$ " copper tubing. Solder a delivery tube near the other end.



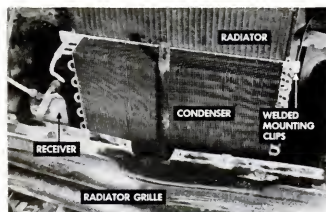
Short Lead Improves Starting. On an older-model Plymouth, I have found that moving the coil from the firewall to the spark-plug cable support makes the engine easier to start. In the new position, the high-voltage wire from the coil to the distributor cap is shortened considerably.—*Ralph Wyant, Indianapolis, Ind.*



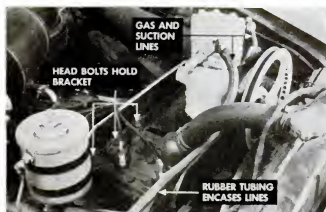
Air-Conditioning a Car

A home-installed mechanical cooling system keeps passengers in this 1948 Oldsmobile comfortably cool, even in the hottest midsummer weather.

By Walter B. Moses, Jr.



Though bolted directly in front of lower part of the radiator, the condenser has been found not to interfere with cooling of the engine.



Cylinder-head bolts hold the cut-away piece of channel on which compressor is mounted. Note sponge-rubber insulation on the tubing.

PITY the poor motorist who must drive on a heat-soaked highway under a broiling sun, cooped up in an upholstered steel box, and propelled by a gasoline-fired heat engine. It's about time we did something to cool him as well as his engine.

Of course you can buy an evaporative-type window cooler, good on long, fast trips in dry country, but it won't help much where heat is accompanied by high humidity—which it is in most of the country. Here mechanical refrigeration, the kind that's custom-installed in high-priced cars, must be used. I've put it in my 1948 Oldsmobile and it keeps the car comfortably cool on the hottest midsummer days in Louisiana.

The actual heat load on a car is tough to calculate, depending as it does on many variables, including window area, speed, outside temperature and humidity, tightness of windows and doors, and insulation in the roof, firewall, and floor. However, it seems



Compressor is aligned with the rear one of two pulleys on the generator shaft. Front channel flange is trimmed to clear boss on compressor.

safe to say that the average car generally requires from one to two tons of mechanical refrigeration. (This means that it needs provision for removing as much heat as would melt from one to two tons of ice every 24 hours.)

A cooling system this size is several times larger than the ordinary room air-conditioning unit for home use. The compressor and condenser in my car are both nominally rated at $\frac{1}{2}$ -ton capacity, but they work fine. This is because the compressor runs faster than before when the car is driven at normal highway speeds, and because the volume of air passing through the condenser is much greater than in fixed applications. I keep the belt on the compressor at all times during the cooling season, handling day-to-day variations with the blower fan.

Three major pieces of equipment comprise the system: (1) the compressor, which changes the Freon® refrigerant from a gas to a liquid and which needs belt power; (2) the evaporator, which absorbs heat from the air inside and which has an electric blower; and (3) the condenser, which discards the heat extracted and which needs a flow of outside air. These parts might be taken from old commercial refrigerators.

Other parts include a receiver to hold the condensed Freon, a thermal expansion valve by the evaporator, and a drain to discharge water removed from the air into a fender well. Installing this equipment isn't too easy, since it involves numerous problems of support and clearance. Most of the work has to be planned on the car itself rather than at the drawing board.

I mounted the compressor on a cut-down piece of 10" channel iron bolted to the head with the existing bolts. Rather than use a single belt on the engine, water pump,

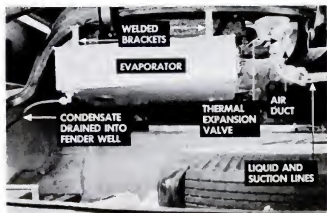
generator, and compressor, I drive the compressor from a special double pulley attached to the generator. This permits removal of the extra belt when cooling isn't needed. The generator was moved back $1\frac{1}{2}$ ", the width of the pulley, and a second pulley was silver-soldered to the first while both were aligned on a mandrel. The pulley on the compressor was grooved out on the lathe to take a standard auto V belt.

The condenser is mounted in front of the bottom half of the radiator by angle clips welded to the radiator frame, to which are bolted matching clips welded to the condenser. Brass bolts hold the assembly in place. Even in extremely hot weather I have been able to detect no increase in engine operating temperature due to air obstruction from the condenser. The receiver is secured by a bolt running up through the dust pan in front of the radiator.

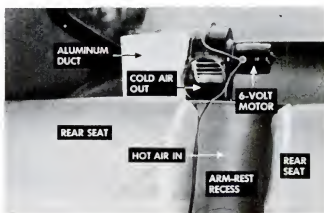
Located to minimize obstruction of trunk space, the evaporator is bolted under the deck behind the rear seat. Air entering the trunk around the seat and through the center arm rest is drawn through the evaporator to be cooled and dehumidified. The moisture it gives up is piped out the left fender well. The air is then drawn up through an aluminum duct and discharged toward the front of the car by the 6-volt fan.

Normal infiltration of outside air is more than adequate to handle ventilation. The blower, connected through a SPDT switch to the regular heater switch, effects a one-minute recirculation of air inside.

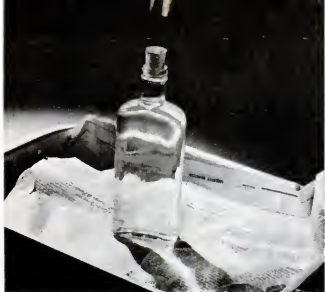
The refrigerant lines are mainly $\frac{1}{2}$ " soft copper and are fitted at several points with necessary flexible connections. I covered them with "spaghetti" insulation of sponge rubber and ran them back inside the right frame channel. END



Where the coolth is produced. Air entering the trunk around rear seat is drawn through the evaporator and ducted upward and forward.



Blower on rear deck directs air toward front of car. All windows and ventilators are kept shut when air-conditioning system is working.



Tap cork sharply and this water-filled bottle shatters into a hundred pieces. Being incompressible, the water transmits the full force of the blow to the sides of the bottle. . . .

Water Wizardry

YOU can squeeze a gas into smaller space, but liquids can hardly be compressed at all. The water experiments on this page demonstrate that natural law.

For the two stunts above, boil the water first to drive out dissolved air. Allow it to cool to room temperature. Then fill the



But look at this. You can drive a nail into a piece of soft wood with a water-filled bottle. The bottle doesn't break in this case because the water won't allow the glass to give.

bottles to the brim and stopper snugly without introducing air.

Holding the hammer at arm's length, lightly tap the cork in the flat-sided bottle. The cork won't go in because the water isn't compressible. Tap a little harder and the bottle will shatter.

For the nail-driving experiment, use a round bottle and glass stopper. Turn the bottle on its side to be sure no bubble is trapped. As a safety measure, hold it with a cloth.—*Kenneth M. Swezey, Brooklyn, N.Y.*



Water compresses air in the famous Cartesian diver. You can make one by putting water into medicine dropper until it just barely floats. Fill bottle to brim and insert cork. Pressing



cork causes "diver" to sink. Here, the incompressible water compresses the air in bulb to a smaller volume. Because of this, the dropper loses its buoyancy and drops toward bottom.

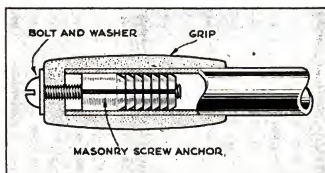


Carriage Becomes Carryall

LUGGING the makings of an outdoor meal from house to fireplace is quite a chore if you have to make several trips. An old baby carriage, retrieved from the attic, was converted to carry dishes, food, linen, and silver



in one haul. The frame is a natural for two drawers and a general utility box on top. Drawers and box are made of redwood. Clear varnish covers the outside and white enamel the inside. The framework is painted jade green and the wheels a bright red.—*F. W. Essex, Maplewood, N. J.*



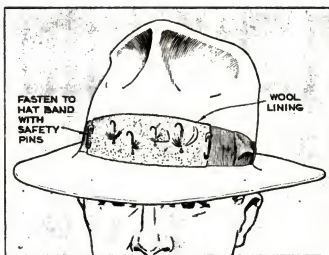
Plug Anchors Bike Grips

TO PREVENT children from removing—and probably losing—the handle-bar grips of their bikes, use this improvised lock. Drill the end of the grip $\frac{1}{8}$ ". Wrap a strip of rubber cut from an old inner tube around an expansion plug and insert it in the handle bar. Replace grip and tighten the $\frac{1}{8}$ "-20 screw.—*W. Quisenberry, Baltimore, Md.*



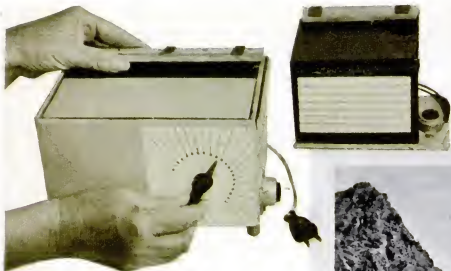
Plastic Pool Is Family Size

MEASURING 6' in diameter, this inflatable plastic pool holds up to 170 gal. of water and is deep enough for youngsters to float in as well as wade. It's made of marine blue Vinylite® by the Bilnor Corporation, of New York City, and is priced at \$25.



Sheepskin Is Fly Carrier

PIN a strip of sheepskin clipped from an old jacket lining to a hatband and you have a ready-made carrier for fishing flies. The flies hook into the wool more easily than into the hatband and they can quickly be removed.—*R. A. Jenkins, St. Louis, Mo.*



Your name can be placed on the border of a photo with either of the two printers at left. They work in the same way as a contact printer. The panels on front are for jotting down exposure data that give best results on different papers.

Border Printer Brands Photos

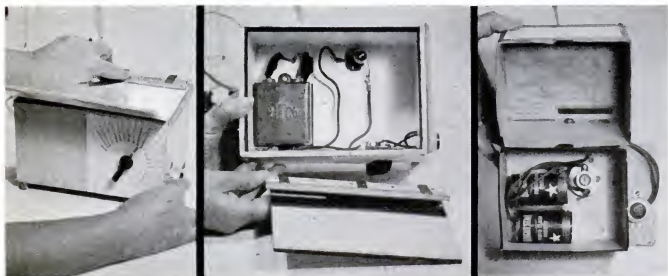


WITH either of these homemade printers, you can put your name and address on photos during the normal developing process.

Both work on the same principle. You make a negative of the desired wording on contrast film and mount this permanently over a slit in the printing box. After taking the paper from the enlarger or contact printer, you slip the edge under the border-printer pressure plate and expose.

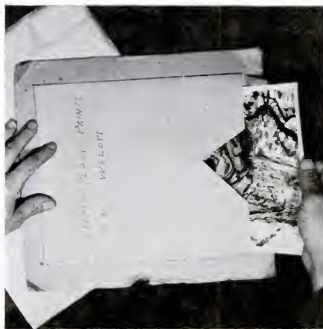
The large printer, housed in a plywood box, has a 6-volt transformer, a rheostat, tail-light bulb, and switch wired in series. The rheostat varies the light for contact or enlarging papers. Glass set flush in the cover supports the taped negative.

In the small one, two flashlight batteries provide the power. Leather hinges join the plywood pressure plate to the alignment stop.—*Clinton R. Hull, Costa Mesa, Calif.*



Exposure is made by slipping edge of the paper under pressure plate, left, and holding it in contact with signature negative while pressing switch. Lines radiating from rheostat pointer

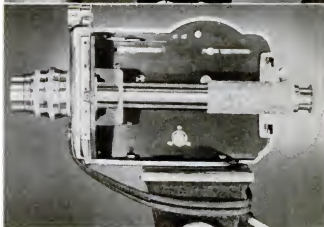
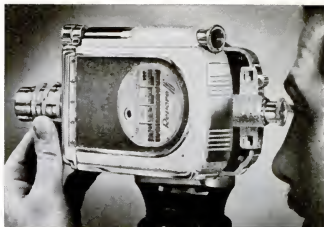
enable you to reset the bulb to any illumination that you've found gives proper exposure on a certain paper. Center, an inside view of the larger printer; at right, the smaller one.



Mailer Protects Photos. Here's a packaging method that helps mailed prints reach their destination in good condition. Select two corrugated cardboards an inch or more larger all around than the prints. On one, center and glue an envelope that just fits the prints. Even though the cardboard corners become dented, the prints are less likely to be damaged.—A. C. Porter, South Bend, Ind.



Safelight Has Three Filters. A rotary safelight announced by the Golden 'B' Manufacturing Company, Cleveland, gives you a choice of three filters—red, green, or yellow—simply by turning the housing. This allows you to suit the filter quickly to the work being done. The light retails for approximately \$11.

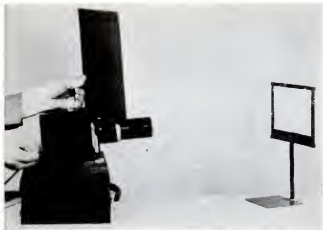


New Finder Centers Close-Ups.

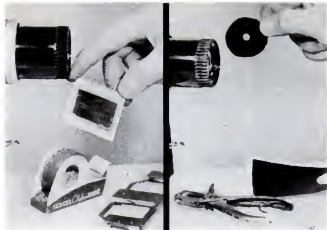
For critical focusing and centering of subjects at distances of less than 6', the Revere Camera Company, Chicago, offers a Thru-Lens Finder² as an accessory for its 16-mm. camera. With the camera on a tripod, you remove the film magazine and insert the finder. When the camera is aimed and focused properly, you remove the finder and replace the magazine.



Bulb Tests Flash Outfit. A flash tester can be made by soldering wires to a flashlight bulb, pushing the bulb into a cord long-shank plug, and connecting the wires to the prong screws. Plug directly into the gun or, for extension sockets, insert the plug in a screw-in receptacle.—Don Pittwood, Moscow, Idaho.



During exposure, stray light is kept off easel with a shield. It could be held in place by cutting a hole and sliding it onto the lens barrel.



Negatives are taped over a blank slide mount and then inserted in the slide holder. Cardboard disk with $\frac{1}{8}$ " hole serves as lens stop.

Color Slide Projector Doubles as Enlarger

SOME photographers operate 35-mm. cameras chiefly for color, only occasionally exposing a roll of black-and-white film. In such cases, they can make fairly satisfactory enlargements from their negatives by using a slide projector as an enlarger.

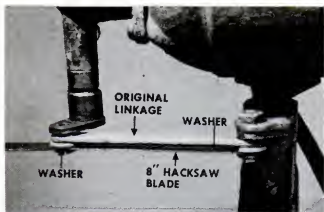
The photos above show how it's done. Adequate enlargements up to 5" by 7" have been made in this way.

A cardboard disk was cut to fit over the

lens and a $\frac{1}{8}$ " hole punched in the center. This permits exposures of about 1 sec. with the 100-watt lamp in the projector. To lengthen the time, the hole could be made smaller or a smaller bulb used.

A display-card holder serves as an upright easel. A weight should be placed on the foot of the holder to prevent movement while inserting the enlarging paper after focusing.—H. Leeper, Canton, Ohio.

Oscillating Fan Agitates Two Film Tanks at Once



UNIFORM agitation of one or two film tanks is possible with this device. Snap two 8" hacksaw blades at the center to provide the four parts of the linkage nearest the tanks. Anneal the metal by holding the ends in a flame and drill for $\frac{1}{8}$ " bolts. Take off the regular drive link from an oscillating fan, (see above), use it as a guide to drill corresponding holes in an unbroken 8" hacksaw blade, and reassemble the link and blade with washers.

Remove the metal rings from two sink stoppers, punch holes to make the stoppers



a tight fit on the reel knobs, and cut slits on opposite sides for insertion of the blades.—H. D. Smith, Los Angeles.

Apple Crates Frame Cabinet

HALF a dozen apple crates, stacked as seen in the inset photo, form the basis of this dining-room cabinet. The cabinet was built by Mrs. O. B. Woods, of Bigfork, Mont., to house her dishes, glassware, silver, and the like.

Besides the boxes, you need about one full 4' by 8' panel of $\frac{3}{4}$ " plywood to duplicate the cabinet. The plywood is used for facings and doors. Hinges and catches from the dime store, a handful of nails, and varnish or paint to suit your taste complete the list of requirements.

Four boxes placed on their sides, two high, form the bottom of the cabinet. A 4" space is left between for the facing to which doors are latched. A fifth box is placed upright at the end of the double tier. Nail the end from another box in the middle of this one as a shelf.

Place the sixth box across the space separating the bottom four. After all the boxes have been nailed in position, face the ends, top, and front with plywood. The cabinet shown rests on the baseboard in a corner, the facing of the right side extending to the floor for support. If not built into a corner, the cabinet should have extensions at both ends to serve as legs.—*Mildred Kelso, Bigfork, Mont.*



Jar Increases Dust Capacity

TIRED of constantly refilling my garden duster, I cut an opening in it and soldered on a standard metal jar lid through which I had cut a hole. This fitting accepts a standard fruit jar, increasing the capacity of the gun several times. The cloth seen in the photos keeps dust from backfiring.—*Clinton R. Hull, Costa Mesa, Calif.*

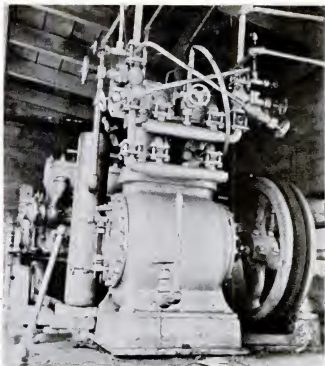


New Loader Picks Up Bales

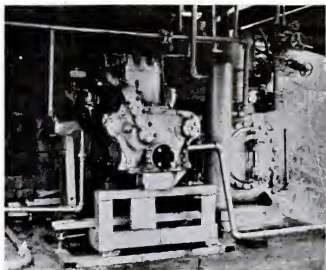
HITCHED alongside a truck or wagon, a new bale loader takes the back-breaking labor out of a familiar farm job. Guides 3' long direct the bale into the elevator as the loader moves across the field picking up hay deposited by the baler.

Made by the International Harvester Company, Chicago, the loader is driven by a chain connected to a sprocket on the axle of two wheels, which are fitted with 6.00 by 16 tires. The loader is 7' high, 12' long, and weighs about 688 lb.





Ammonia compressor, bought secondhand, is backbone of air-conditioning system that cools and dehumidifies an eight-room house.



Gasoline motor, run on natural gas, furnishes the power for the compressor and a centrifugal pump that recirculates water from the pool.

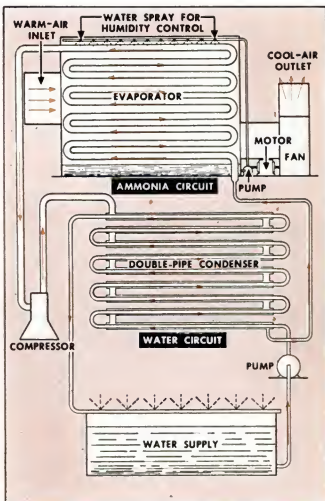


Condenser coils are located behind back-yard swimming pool. Water from pool absorbs heat taken from house. Compressor is at far left.

Ammonia Plant Cools Home Air

AN AMMONIA refrigeration plant cools the Little Rock, Ark., home of Don Leveck. The used ammonia compressor and auxiliary equipment cost \$500. Energy for the pumps is furnished by a gasoline engine, which is run on natural gas.

Mr. Leveck's forced-air heating plant and back-yard swimming pool are used in the cooling system. House air, ammonia-cooled in the air chamber near the furnace, is filtered and washed by water sprays and forced back into the rooms by the furnace fan. The compressor sucks ammonia gas from the house cooling unit and forces it through condensing pipes which surround smaller pipes carrying water from the pool. In a liquid state, the ammonia is sent back to the house to absorb more heat. —*Ruth D. Arnold, Little Rock, Ark.*



Schematic view of three-element cooling system shows house's heating plant, double-pipe condenser, and swimming-pool water supply.



Eggs Roll into Collecting Pan

COMMUNITY laying nests for poultry made by the Russel Manufacturing Co., Caro, Mich., are said to do away with the necessity of washing and buffing the eggs.

The nest floor is a sloping wire screen. When laid, the eggs roll down the screen into a collecting compartment outside the nest itself. A hinged top swings back, as above, to give access to the eggs.

Each nest, made of aluminum and steel, has four entrances for the hens. The interior is divided by curtains. The front of the laying compartment is hinged for easy cleaning. Shallow trays under the screen floor catch dirt that falls through.



Farm Saw Mounted on Sled

WE USE an old sled as the base for the farm buzz saw. Mounted on the sled, the saw can be easily skidded to a new location when the need arises. While the saw is in use, the sled is staked to give a firm base.—Leonard O. Timm, Bennington, Neb.



Electric Vibrator Drops Seeds

ACTUATED by a single flashlight cell, a vibrating planter made by the Park Products Co., Lombard, Ill., is said to ease the job of row-planting small flower and other seeds. When held as above, the vibrator goes into action. Placed in the trowel-shaped hopper, hard-to-handle seeds will drop into the furrow one by one.

Engine Moves from Job to Job

HERE'S a two-cycle gas engine that's designed as a jack-of-all-jobs. Made by the Gresengine Corp., Antioch, Ill., it is intended for various light-duty applications about the farm and elsewhere. One feature is that the base is separate from the engine proper. After a base has been mounted and aligned at each location where you need occasional power, you can quickly move the engine from job to job. The engine shown has a 1.7-hp. rating; more powerful ones are planned.



Seals Frozen-Food Packages

A LIGHTWEIGHT electric sealer for closing plastic bags prior to home freezing of foods is now offered by Sears, Roebuck and Co. Plugged into a 115-volt outlet, it seals a bag in two to five sec. When you release the normally separated handles, a spring clamps heated jaws on the mouth of the bag. Price, about \$4.



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Used for heavy duty industrial applications on shop air lines or high low pressure systems. With 100 lbs. air pressure, will deliver 1000 lbs. pressure at the ram shaft. All steel construction. Adjustable cushions at both ends of cylinder. Shot dia. 1 1/2". Pressure mounting with clevis on ram shaft. 2 1/2" double-acting strokes. 3" long. 1 1/2" overall mounting with closed. 7" overall width. 891 1/2 lbs. net wt. Gov't acq. cost \$101.85. AN EXCELLENT VALUE for (Item #61)



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Brand New Pneumatic Compression Rifle

MADE BY CHICAGO PNEUMATIC TOOL CO.

Equipped with built-in control valves for use with cable operated remote control. Has 6" dia. actuating cylinder with right angle head. Bore is 2 1/4" x 4". Height 4". Ram assembly adjustable for height. Approx. wt. 1300 lbs. A \$150.00 value. (Item #62)

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Model CP625-T812

ROSS 4-Way Foot Operated AIR VALVE

MODEL

BRAND NEW. For double-acting pneumatic devices. Fine for operating presses, air vices, air machinery of many types. Heavy duty cast construction. No neutral position. Maintains pressure against the piston when the foot control is in the "off" position. Threaded for 1 1/2" pipe. Dimensions of valve body: 11 1/2" x 11 1/2" x 7 1/2". Net wt. 28 lbs. A \$64.00 value for only—

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LOGAN 4-Way Foot Operated AIR VALVE—Model 6520

BRAND NEW. For double acting pneumatic devices. Fine for operating air vices, presses, air machinery of many types. Heavy cast construction. Threaded for 1 1/2" pipe. Dimensions of valve body: 8 1/2" x 5 3/4" x 7 1/2". Net wt. 28 lbs. Gov't acquisition cost \$12.00. AN OUTSTANDING BUY AT (Item #59)

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A super value for all types of intermittent service in pumping large volumes of fluid in home, farm and industrial service. Ideal for home water systems, draining basements, fire protection, etc. On the farm for watering stock, draining ponds, sprinkling, etc. In shops and factories for all types of pumping service.

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- Stock Watering
- Fire Protection
- Draining Ponds, Tanks, etc.
- Industrial Pumping

MOVE LARGE VOLUME QUICKLY. When operated at 1750 RPM, will move 88 gallons per minute on a 22 foot head; at 3500 RPM on 52 foot head will pump 88 gallons per minute. May be run with electric motor, gas engine or power take-off on tractor.

COMPLETE ENGINEERING REPORTS AND OPERATING INSTRUCTIONS FREE WITH PUMP. Pump has cast aluminum housing—accurately machined bronze impeller vanes. Complete with mounting bracket and 3/4" x 1/2" ball nut. All points on sealed ball bearings with grease run filling. Has 1 1/2" threaded inlet flange, two 1 inch outlets. Use necessary for mounting. Made for Packard Motor Car Co. for use in Rolls-Royce Merlin Aircraft engines.

Greatest Pump Value in Years Complete with Pulley and Mounting Bracket—Ready for use. Shipping weight 25 lbs. You can't beat this value at anywhere near this price. Satisfaction guaranteed.

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Brand New

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BRAND NEW 3-IN-ONE GEAR PUMP. Three independent gear pump section running off of one shaft; for single or multiple pumping. Has 1/2" pipe threaded connections. Shipping wt. 10 lbs. Gov't acq. cost \$275.00. (Item #14) F.O.B. Chicago \$9.95

AIR FORCE WOOD PROPELLER. BRAND NEW—Made of polished laminated hard wood, 90 inches long, shipping weight 7 1/2 lbs. (Item #30) F.O.B. Chicago \$9.75

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APPLICATIONS: oil burners, aquariums, fluid metering, fuel pump, cool post grinder, coolant pump, pressure lubricating pump, general industrial, etc. Compact—Brand New MOTOR MFD. BY BLACK & DECKER; double ball bearing series wound, continuous duty, 1/30 H.P. electric motor, rated 12,000 R.P.M. Transformer included for use on 110 V AC current. Also applicable for 24-32 V DC. PUMP MFD BY WELDON TOOL CO. with standard 1 1/2" tubing ports, rated 2 G.P.H.; remove pump and use motor as high speed grinder. OVERALL DIMENSIONS: 7 1/2" long x 3 1/4" wide x 3 1/4" high. Approx. wt. 5 lbs. \$51.00 value (Item #31) postpaid

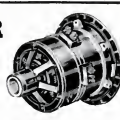


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All Manganese Bronze for spraying D.D.T., 2-4-D, Sulphur. Pressure 15 to 14 gallons per minute—1500 RPM. Will not rust, pit, foul or freeze up. Use rubber hose inlet. Pump or tubing outlet. Equipped with 1 1/2" standard pipe thread port. Wt. 10 lbs. Dimen: 10" x 8" x 8". Standard 1/2" manganese bronze shaft with keyway. Gov't. Acquisition cost \$62.00. NOW ONLY \$15.00 F.O.B. Chicago (Item #30)

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- Item # 20. Double action, 2 3/8" bore, two-way solid 5/8" alloy steel shaft. (Will lift 4400 lbs. in one second with Logan Pump.) . . . **\$16.50** postpaid
- Item # 13. Double action, 3" bore, 8 1/2" stroke. All steel hydraulic cylinder, will lift up to 12,000 lbs. (7000 lbs. in 3 seconds with Logan Pump.) Complete with brackets. Wt. 12 lbs. . . . **\$19.50** postpaid
- Item # 31. Double action, 3 1/2" bore, 8" stroke. (Will lift 9000 lbs. in one second using Logan Pump.) Complete with fittings. Wt. 15 lbs. A \$92.00 value. . . . **\$22.50** postpaid
- Item # 15. Double action, 3" bore, 8 1/2" stroke. Hydraulic cylinder will lift 7070 lbs. in 5 1/2 seconds using Logan Hydraulic Pump. Especially suited for farm and construction machinery. Wt. 12 lbs. . . . **\$27.50** postpaid
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- HI-PRESSURE FITTINGS for cylinders and valves available at 35c ea. for 3/4" pipe and 50c ea. for 1/2" pipe.

Hydraulic Control Valves BRAND NEW

- Item # 24. Four-way control valve for use with double action hydraulic cylinder. May be used with 1500 P.S.I. hydraulic system to open and close hydraulic cylinder. Brand new. Ship. 12 lbs. . . . **\$7.95** postpaid
- Item # 26. Four-way control valve for use with two hydraulic double cylinders. Each cylinder may be operated independently of the other or in conjunction with the other. Oil may be locked in any of the cylinders to hold the piston. Brand New. Ship. Wt. 6 lbs. A \$60.00 value. . . . **\$10.95** postpaid
- Item # 28. A two cylinder double action valve with a unique arrangement allowing the operator to raise both cylinders simultaneously, to lower them simultaneously, or to raise one and lower the other at any predetermined rate and speed. Brand New. Ship. Wt. 8 lbs. A \$75.00 value. . . . **\$14.95** postpaid

LOGAN Double-Action Pneumatic—Hydraulic PRESS

\$300.00 value offered at a fraction of original cost

Using air or oil, this device is ideal as a punch press, vise, arbor press, etc. An excellent tool for industrial and shop use.

Use 150 lbs. of air pressure or 250 lbs. of oil pressure. Cushioned double action "Logan" Model AC ram, 6" bore and 6" stroke. Capable of up to 4200 lbs. of pressure using air.

Has 3" throat. Lubricated gibs provide perfect alignment. Has adjustable work space. Hardened alloy steel piston rod 1" diameter. Frame constructed of steel with plate. Manufactured by Sipp-Brand Engine Co. Unit is 48" high. Base is 9 1/2" wide by 18" deep. Wt. approx. 310 lbs. A \$300.00 value. . . . **\$79.50** postpaid

(Item #7) STANDING BUT F.O.B. Chicago

18" Wire Spoke Wheel

BRAND NEW. For use on motorcycle or adaptable for motor cycles, trailers, small trucks, any wheeled vehicle. With bearing races and gear. Takes 18" tire. Wt. 18 lbs. . . . **\$3.95** postpaid

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For pneumatic tools, filling hi-pressure vessels, paint spraying, insecticide vaporizing and other uses.

Rated 450 P.S.I. at 1200 R.P.M. Used on Packard V8 Engine. This aluminum air pump is made with air filter intake weighs only 4 1/2 lbs. . . . **\$15.00** postpaid

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LOGAN HEAVY DUTY OIL HYDRAULIC PUMP

BRAND NEW . . . for operating hydraulic cylinders and hydraulic motors on tractors, bulldozers, construction equipment, lift trucks, industrial applications, etc. Delivers 8 GPM at 1200 RPM at 1000 P.S.I. using 3/4" H.P. Has 1 1/2" pipe threaded inlet, 3/4" pipe threaded outlet, 3/4" shaft with flat and keyway for direct or pulley drive. Has chance with 4 bolt holes for convenient mounting. Ship. wt. 22 lbs. Overall dimension 7" L x 5 1/2" H x 5 1/2" W. A \$105.00 value. FOR ONLY . . . **\$22.50** postpaid

F.O.B. Chicago (Item #29)



LOGAN HEAVY DUTY OIL Hydraulic Control Valve

BRAND NEW control valve with built-in adjustable relief valve. Operate one double acting hydraulic cylinder or two cylinders as one or a reversible hydraulic cylinder. Valve handles lateral movement. Made of rugged cast aluminum alloy. Open center unloads the pump in neutral position. Throttling control allows operator to regulate the speed of movement of the hydraulic cylinder or motor. Has removable mounting brackets with 4 bolt holes. 3/4" pipe threaded connections. Overall dimension 12 1/2" H x 8 1/2" D x 8" W. Ship. wt. 17 lbs. Govt. Acquisition Cost over \$100.00. An Excellent Buy. F.O.B. Chicago



(Item #37)

G-1 Stainless Tank

Use these tanks on compressors, for fire indicators, pulsation chambers, boost, buoys, hydraulic reservoirs, fluid and milk containers, etc. Tough. Light. 450 lbs. P.S.I. Aviators. Breathing Oxygen bottles, type G-1, 2100 cu. in. (approx. 9 gallons) int. val. 2 1/2" x 12" 1/2" threaded openings at each end. Wt. 19 lbs. .051" thick. Price . . . **\$4.95** postpaid

(Item #63) F.O.B. Chicago



HYDRAULIC PRESSURE GAUGE

BRAND NEW. Ideal for high pressure hydraulic systems, adjusting pressure, relief valves, etc. It range to 4000 P.S.I. Black plastic case 2 1/2" square. Black instrument face with white pointer and numerals. Worth many times this low price of . . . **\$2.95** postpaid

(Item #36)



HAND HYDRAULIC PUMP Brand New

Used for hydraulic jacks, presses, hoists and other hydraulic applications. For operating hydraulic cylinders to pump oil or hydraulic fluid under pressure. Hand pump has built-in check valve and is capable of delivering 1000 lbs. of pressure. Has alloy aluminum housing. Dimension 8" long x 3 1/2" wide x 2 1/2" high. Ship. wt. 3 lbs. A \$45.00 value. . . . **\$8.95** postpaid

(Item #11) F.O.B. Chicago



Vickers MF9 Hydraulic PUMP or MOTOR

complete with mounting kit ready to install



\$75.00 value postpaid

Pump is compact, powerful, rated 1,000 P.S.I., 507 cu. in. per revolution, 8 gal. per min. at 1750 RPM. Change rotation by reversing flow. Delivers up to 6 M.P. Requires 1/2 to 6 M.P. to drive directly or by pulley. BRAND NEW. Mounting kit has been especially designed to provide maximum utility and ease of mounting MF Series Vickers Pumps. Brackets are constructed of heavy steel plate. Shaft is made of 1/2" steel with one end splined to fit pump; other end of shaft has machined flat for mounting a standard pulley with 1/2" hole. Shaft runs in oilite bronze bearings.

(Item #18) Pump only . . . **\$14.95** postpaid

(Item #28) Mounting kit only . . . **\$4.95** postpaid

(Item #39) Both as complete unit . . . **\$19.90** postpaid

ADJUSTABLE RELIEF VALVE. (Item #34) . . . **\$2.95** postpaid

HYDRAULIC FLUID. (Item #31) Per gallon . . . **\$1.75** postpaid

10 ft. length of Hi-Pressure HYDRAULIC HOSE with 1/2" female pipe thread fittings. (Item #27) . . . **\$3.95** postpaid

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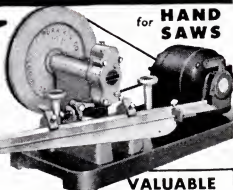
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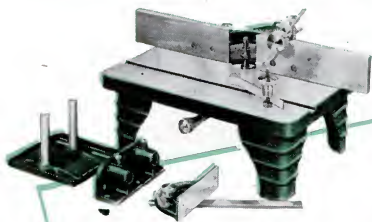
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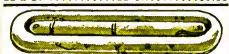
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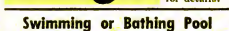
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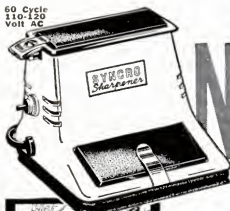
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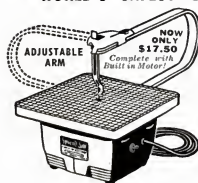
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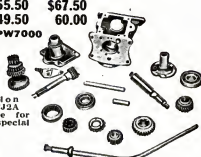
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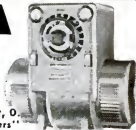
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Complete outfit consisting of compressor, pressure tank, air gauge, air chuck, 20-ft. hose, pop valve, copper tubing with 4 brass flared fittings for connecting compressor to tank, 4-way cross and 3 nipples—complete outfit, only... (Wt. 40 lbs.)

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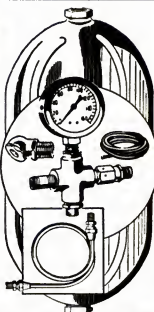
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Equipment
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\$11.50
Wt. 15 lbs.

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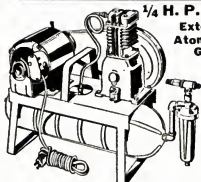
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Paint Sprayer mounted on 6 x 24 inch tank, 1/4 H.P. 110 V. 60 CY. Heavy duty motor with overload relay, 10 ft. cord and plug, V Belt drive, piston-type compressor with 2 Compression rings, 1 oil ring, 2 inch bore, 1 1/2 inch stroke, displacement 2.86 C.F.M. at 60 lbs. pressure. Safety Valve. Gun external atomizing. Flat and round spray, quart cup, maintains 35 to 40 lbs. pressure. Oil and water extractor, 1 air gauge, 20 ft. heavy duty 2-braid air hose with leak proof fittings, complete with carrying handle. Net weight 34 lbs., ship. wt. 60 lbs.

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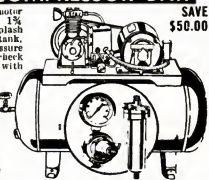
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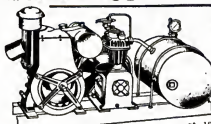
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25 1/2" Wide
15 1/4" High
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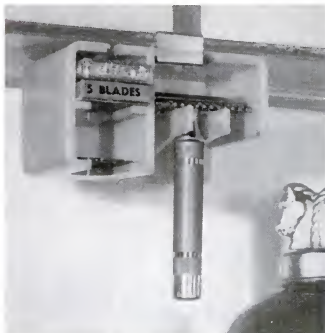
Grease-Draining Frying Pan.

Pushing the plastic lever in the handle of this frying pan opens the valve and lets you drain off excess fat. A slight tilt lets the grease drain out with no chance of tumbling out the food. The 9 1/2" pan is made of cast aluminum by the Hollis Company, of Newark, N. J. It sells for about \$5.

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Razor Holder Clips on Shelf. Clipped to the underside of a shelf in the bathroom cabinet, this plastic holder keeps both razor and blades up out of the way. It has compartments for new and used blades. Screws are furnished for mounting beneath wooden shelves. Carvanite Products, Los Angeles, prices the holder at about 30 cents.

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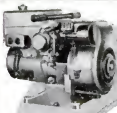
Operates spray guns, rock drills, tampers, paving breakers, sandblasting . . . Uses only 1 gallon of gas an hour!



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Aids to Modern Living



Lifting Pencil Lights Lamp. Remove the pencil to jot down a note and the light goes on. Replace the pencil and the light turns off. The Mem-O-Lite®, designed for use on night tables and telephone stands, is manufactured by the Bollman Industries, of Kansas City, Mo. It's made mainly of plastic and comes in black, walnut, or ivory.



Serving Tongs Unhinge. Made of Lucite® by Amos Molded Plastics, Edinburg, Ind., this salad server can be used as a one- or two-piece unit. The hinge has no pin. To assemble, the end of the fork handle is inserted in the grooved end of the spoon handle and the two brought together. Reversing the operation separates the pieces.



Juicer Squeezes Whole Fruit. You can skip a knife and cutting board with this juicer. Press down on the arm and it cuts and squeezes a whole orange or lemon at a time. Knives in the bowl cut the fruit as it is compressed. It's made by the Van Dusen Engineering Co., Escondido, Calif., and priced at about \$9.



Pouring Spout Snaps On. Adjustable to openings from 1" to 1 1/2" in diameter, this metal pouring spout fits most glass and metal containers, including many milk bottles. When used on bottles, the spout is tilted upwards at a sharp angle. It also may be used on faucets. The maker is Abbott Industries Co., New York City.

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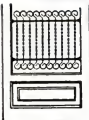
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This handsome grille dresses up your door and braces it, too! Strong and sturdy; silvery satin finish will not rust or tarnish. Completely adjustable for windows or doors. Comes complete with screws. Can be installed by anyone in minutes. Also makes perfect window guard.



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TO: Reader
FROM: Editor

PS Story Grows Into Book



FOR more than 20 years, Dr. Donald H. Menzel, professor of astrophysics at Harvard, has been a friend and occasional contributor to *POPULAR SCIENCE*. One of his articles, which PS published under the title "Celestial Yardstick" in January 1943, told how the distance from the earth to the sun was measured.

That same year, Dr. Menzel was called to active duty as a Commander in the U.S. Navy. Censorship then prevented him from reporting many further advances in men's knowledge of the sun. But now, secrecy about solar research is no longer necessary; Dr. Menzel has resumed his research, teaching, and avocation of popular-science writing; and that 1943 article has grown into a book.

It is called *Our Sun* and has been published by Doubleday & Co. as another volume in a series of "Harvard Books on Astronomy." The first chapter is a revised and expanded version of the article PS published. The book is full of facts which you may enjoy pondering while basking in the sun's rays this summer. For example:

- Every square inch of the sun's surface shines with the intensity of 300,000 candles.
- Every second, the sun converts about 4,000,000 tons of matter—the equivalent of 60 ships as big as the *Queen Mary*—into energy enough to supply the world with power for 2,000,000 years.
- The sun's equator revolves faster than other regions, completing the circuit in

about two days less time than a point at a latitude of 40 degrees.

- A single sunspot, in April 1947, was so big it could have contained 100 earths.

Gee-whizzy facts like these, however, are merely the spice in Dr. Menzel's book. He is mainly interested in telling how such information about a body 93,005,000 miles away was acquired, and how solar research is contributing to knowledge of radio, weather, and even atomic phenomena.

Harvard professors of mathematics, chemistry, and other subjects frequently refer reporters who pester them with questions about what they are doing to Drs. Menzel, Shapley, or Bok over at the observatory, and *POPULAR SCIENCE* writers often have been amazed how much the astronomers could help them when they were writing about other sciences. This book shows why. The men studying the sun and stars have to know a great deal about many sciences.

Hence, they are, in a sense, "general scientists," who often can explain new developments better than specialists in narrower fields. Dr. Menzel is one of the best of these "explainers," and we're seizing this opportunity to congratulate him on having written a book about the sun which should interest almost everybody. That he has done so comes as no surprise to PS editors.

Volta Toney

100-100000-100000

This One



RPEU-DJC-NOCG

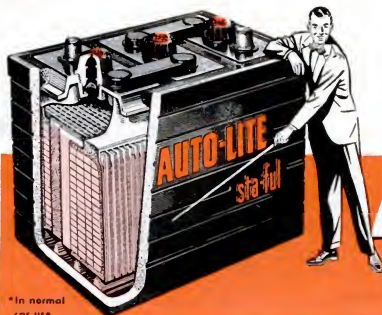
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A revolutionary new development, the Auto-Lite "Sta-ful" Battery, protects you against a major cause of battery failure . . . damage to plates due to liquid loss. This new "Sta-ful" Battery design permits a liquid reservoir with 3 times the capacity of ordinary batteries . . . keeps plates fully covered and active months longer in normal car use.

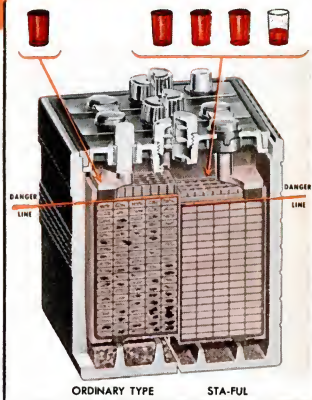
In addition, "Sta-ful" has Fibre-glass mats to hold the power-producing material in the plates for longer battery life. To get more for your battery dollars, replace with an Auto-Lite "Sta-ful". Money cannot buy a better battery.

AUTO-LITE BATTERY CORPORATION
Toledo 1 Ohio

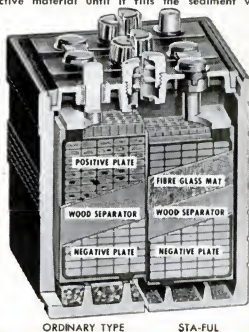


*In normal car use

Because of a unique construction, the new Auto-Lite "Sta-ful" Battery holds more than 3 times the liquid reserve of ordinary batteries.



Note how the protective Fibre-glass mat retains the power-producing material in the positive plate while ordinary battery plates shed the active material until it fills the sediment well,



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Amazing New LOW PRICED Electric Sprayer For Home Use Makes Painting Easy!

SAVE MONEY, TIME, WORK! GET PROFESSIONAL SPRAYING RESULTS!

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INSECT CONTROL—Efficiently aids extermination of fleas, bedbugs, flies, mosquitoes and other pests. Fine for mothproofing clothes!



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PULL THE TRIGGER
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**TRY IT
10 DAYS FREE
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Yes, now you can do a professional painting job on everything in and around your house with this amazing, brand new, self-contained electric paint sprayer. Just fill the big, 25-ounce capacity, interchangeable mason jar with any kind of ordinary oil-base liquid—lacquer, glossy paint, enamel, varnish, shellac, residual type insecticides, light oils, moth sprays, disinfectants, etc. Then plug the 8-ft. insulated cord into any 110-volt A.C. household outlet—pull the trigger—and get satin-smooth, professional results every time!

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VIBRO-SPRAYER paints twice as fast as a brush, saves strain, fatigue, backache and sore muscles. Paint goes on FASTER, SMOOTHER and far more EASILY than with a brush. Adjustable spray control allows wide or narrow spray, thick or fine, as the job requires. Spray radius is always under complete control. VIBRO-SPRAYER cannot clog or drip—and is amazingly simple to clean. What's more, VIBRO-SPRAYER is SAFE! Will never break in use as there is NO pressure in the jar.

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Not only does VIBRO-SPRAYER paint faster, smoother, more easily than a good brush, but it actually costs less! And because VIBRO-SPRAYER applies paint more evenly and uniformly, you use LESS PAINT—save the cost of the sprayer in just a few months! In addition, VIBRO-SPRAYER shoots a fine, even spray into deep crevices where ordinary paint brushes can't reach, makes short work of rough or pitted surfaces that are so difficult to brush.

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TASTE

THROAT

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